Table K-91: Air Quality (SO_2, NOx and H_2S)

Unit: ppm

Sampling Point	WHO Guidelines			Results		
	SO_2	NOx	H_2S	SO_2	NOx	H_2S
1				0.425	<0.01	<0.025
2	0.04	0.02		0.625	<0.01	<0.025
3	(24hours)	(1 year)		0.6375	<0.01	<0.025
4			---	0.1	<0.01	<0.025
5	0.175	0.106		0.175	<0.01	<0.025
6	(10 min)	(1 hour)		0.1625	<0.01	<0.025
7				0.5375	<0.01	<0.025

Particulate Maters

Table K-92 shows results of the analysis of suspended particles (particulate maters, PM) in the air. A PM10 concentration (particles smaller than 10 microns) varies between 0.01 and 0.035 mg/m^3; and a concentration of particles smaller than 4 microns that varies between 0.014 and 0.029 mg/m^3). Points No 4 and No 5 registered the highest particles concentrations. It is important to point out that sampling was performed during the rainy season and that higher levels could be expected during the summer.

Table K-92: Air Quality (Particulate Matters)

mg/m^3

Sampling Points	Particles <10 microns			Particles <4 microns		
	Average	Minimum	Maximum	Average	Minimum	Maximum
1	0.013	0.006	0.24	0.009	0.005	0.122
2	0.013	0.003	0.228	0.014	0.002	0.058
3	0.029	0.021	0.105	0.023	0.018	0.049
4	0.035	0.012	0.68	0.025	0.014	0.155
5	0.031	0.017	1.057	0.029	0.017	0.285
6	0.020	0.012	0.542	0.025	0.013	0.493
7	0.022	0.007	0.379	0.014	0.006	0.154

b.1.6 Noise and Vibrations

Noise

The results obtained for the noise tests are presented in Table K-93 and Table K-94. As it can be seen, the sound pressure levels identified vary from a minimum of 28 dBA at point No 3 to a maximum of 91.3 dBA at point No 1 (Chivo Chivo Road). Average (Leq) noise levels vary from 43.7 dBA at point No 6 to 60.3 dBA at point No 4 (DIMAUD offices). Results indicate that areas more traveled by vehicles present higher average (Leq) noise levels (points No 1, 4, 5, 7). Those areas farther away from traffic or heavy machinery present lower average (Leq) levels (points No 6, 2 y 3). For this baseline study, measurements performed at

points No 3 y No 6, that are located away from traffic from heavy machinery and activities performed at the landfill can be considered as "ambient" levels.

Because of the previous discussion, it can be said that the activities that take place at the landfill have caused an increase in the noise levels, nevertheless, they are at acceptable levels for industrial areas. Night measurements indicate that noise levels are lower during the night since these range between 40.2 dBA at point No 6 (Chivo Chivo Road, under power transmission line) to a maximum of 75.2 dBA for point No 3 (Pedestrian Overpass over the Mocambo River towards Kuna-Nega). Average (Leq) noise levels varied from 41.3 dBA at point No 5 to 53.8 dBA at point No 1 (Chivo Chivo Road, near existing well #1).

Table K-93: Daytime Noise Level

Point	Description	Max. dBA	Min.dBA	Leq dBA
1	Chivo Chivo Road, near existing well #1	91.3	32.3	52.0
2	Kuna-Nega settlement, near the Mocambo river	83.7	34.6	50.7
3	Río Mocambo creeks' junction "Y"	83.0	28.0	45.8
4	DIMAUD offices, near existing well #2	80.9	43.9	60.3
5	CUSA quarry	83.3	38.1	55.9
6	Chivo Chivo Road, under the power transmission line	66.3	34.3	43.7
7	Entrance to the Cerro Patacon landfill – Truck weighing station	89.1	43.9	59.9

Table K-94: Nighttime Noise Level

Point	Description	Max. dBA	Min.dBA	Leq dBA
1	Chivo Chivo Road, near existing well #1	73.6	44.5	53.8
2	Kuna-Nega settlement, near the Mocambo river	54.6	45.0	46.9
3	Río Mocambo creeks' junction "Y"	75.2	52.3	53.6
4	DIMAUD offices, near existing well #2	74.4	48.3	53.5
5	CUSA quarry	65.8	35.8	41.3
6	Chivo Chivo Road, under the power transmission line	63.7	40.2	45.7
7	Entrance to the Cerro Patacon landfill – Truck weighing station	73.2	47.4	49.3

Vibration

The results of airborne vibration are summarized in Table K-95. In general terms, two sample points (Point No 4 and No 7) stand out for having consistently higher sound pressure levels than low frequencies. These two points correspond to the areas traveled by trucks (entrance to the landfill and the DIMAUD offices) and registered sound pressure levels between 63.5 dB and 60.9 dB at a frequency of 31 Hz, respectively. It can be noted that these sound pressure levels at a low frequency could produce a light vibration sensation in the human body and is mainly due to the flow of heavy machinery.

Table K-95: Results of Vibration Measurement at Different Frequencies

Unit: dB

Frequency (Hz)	Sampling Point						
	1	2	3	4	5	6	7
31	49.6	57.3	59.6	63.5	55.9	51.9	60.9
63	50.3	53.6	57.7	66.8	56.6	54.9	62.2
125	41.5	44.0	44.5	61.7	52.4	47.7	58.2
250	29.5	35.8	31.7	55.6	41.0	36.7	46.4
500	30.9	38.5	33.7	50.4	37.5	28.2	44.6
1 K	27.9	39.8	32.8	50.3	38.6	29.0	50.3
2 K	35.7	38.7	32.1	48.4	34.5	30.3	50.8
4 K	44.4	45.1	34.5	35.9	27.4	28.4	46.8
8 K	46.6	36.9	36.0	29.8	29.7	30.8	32.9
16 K	34.0	30.5	29.5	33.1	33.0	33.0	30.8

b.1.7 Flora and Fauna

A field survey on flora and fauna of the project site was carried out. In order to have a broad picture of current situation, the survey conducted not only at the project site but also several sites in and around the Cerro Patacon Final Disposal Site as shown in Figure K-58. Among the survey sites, Site 2 Mocambo River Bridge represents the situation of the project site.

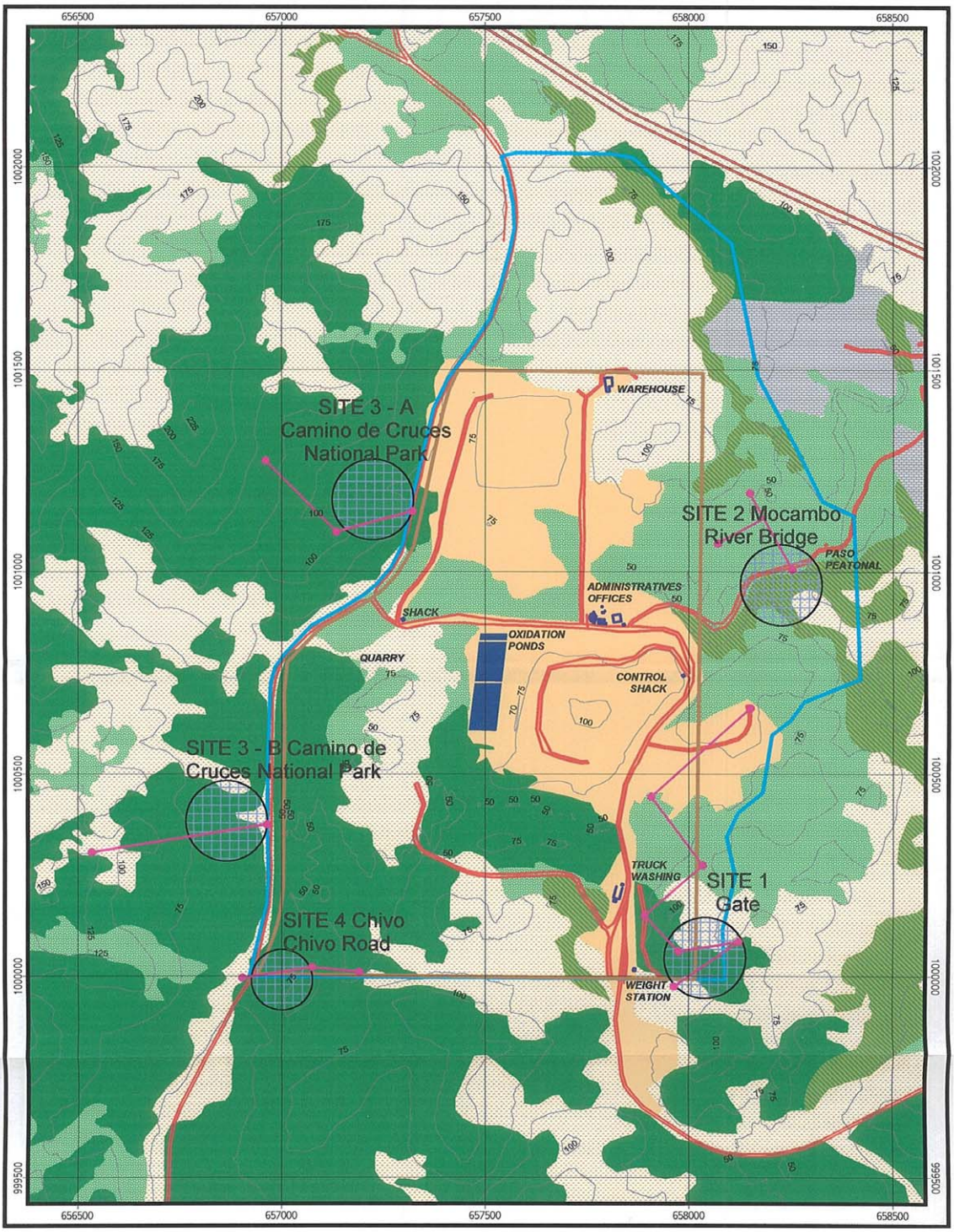

Figure K-58: Flora and Fauna Survey

i) Flora

Overview

At the Site 2 (the project site), vegetation is fairly disturbed than other sites, except for the presence of a young gallery forest that locates on the margins of the Mocambo River, which is also disturbed but to a lesser degree. In the gallery forest dominant tree species observed are cuipo (Cavanillesia platanifolia) and espavé (Anacardium excelsum). To the north of this site, the dominant vegetative community is herbaceous growths, although some old and dispersed trees are seen, as well as small groups of pioneer trees. This situation has been caused by intense and selective deforestation that was carried out on the original vegetation. The forest floor is dominated primarily by invasive species such as the canal grass (Saccharum spontaneum) and la pata de gallina (Panicum sp.). These alternate with a few pioneer brush species, some small trees and herbaceous plants. These invasive species have high reproductive and propagation power, primarily in bare soils. At the north of the project site, a small hill without any tree vegetation and dominated primarily by herbaceous plants such as the canal grass is be found.

Threatened Species

Until recently, there was no official listing of the state of conservation of Panamanian flora species. However, after a series of workshops carried out by INRENARE (ANAM) in conjunction with local specialists, there is currently a listing of more than 4,000 species of plants considered to be threatened to a certain degree. The project site (Site 2) is an extremely disturbed area, which is made up primarily by vegetation in early stages of regeneration, where pioneer species are commonly found. Only one threatened species at national protection level is reported as shown in Table K-96. Meanwhile, the existence of 10 species considered to be threatened at the national and international level were registered over the all survey sites (See Table K-97). Most of such species in danger were found in Camino de Cruces National Park.

Table K-96: Results of Survey on Flora (Site 2)

Vertical	Family	Scientific Name	Common Name	Protection Status
CANOPY ± 10 - 15 m	Bombacaceae	Cavanillesia platanifolia	Cuipo	-
		Pseudobombax septenatum	Barrigón	-
	Anacardiaceae	Anacardium excelsum	Espavé	-
		Spondias mombin	Jobo	-
	Burseraceae	Bursera simaruba	Indio desnudo	-
	Cecropiaceae	Cecropia peltata	Guarumo	-
	Sterculiaceae	Guazuma ulmifolia	Guácimo	-
	Tiliaceae	Apeiba tibourbou	Cortezo	-
FOREST FLOOR	Heliconiaceae	Heliconia latispatha	Platanillo, chichica	-
	Gramineae	Saccharum spontaneum	Paja canalera	-
		Panicum sp.	Pata de gallina	-
	Marantaceae	Calathea sp.	Bijao de monte	EP? (Pmá)
	Adiantaceae	Adiantum sp.	Helecho	-

Table K-97: Threatened Species found in the Survey

Scientific Name	Common Name	National Protection	IUCN
Astronium graveolens	Zorro	V	-
Scheelea zonensis	Palma real	V	-
Solanum sp.	-	V?	-
Calathea sp.	Bijao de monte	EP?	-
Platymiscium pinnatum	Quira	CR	-
Pachira quinata	Cedro espino	-	V
Ardisia sp.	Uvito de monte	V?	EP?
Annona spraguei	Negrito	-	V
Cecropia longipes	Guarumo	EP	EP
Dalbergia retusa	Cocobolo	EP	V
Total	10 spp.	4V; 3 EP; 1CR	3V; 2EP

Note: V= Vulnerable, EP= In Danger; CR= In Critical Danger, ?= The species was only identified to the Genre level and its threatened status is uncertain.
IUCN: International Union for Conservation of Nature and Natural Resources

ii) Fauna

Overview

The Site 2, the project site, is very disturbed, in spite of the fact that a river forest that runs along the Mocambo River gives the impression that the area is well preserved. However, this area is primarily dominated by herbaceous growth. In the surrounding areas, a series of communities such as Kuna Nega and the San Francisco Valley have been established, which add to the perturbation of the natural state. The only mammal registered in this area was a gray squirrel and as far as birds are concerned, very few species were captured or observed.

The species of birds observed included the colibrí colirufa, red-crested woodpecker (Melanerpes rubricapillus), blue chested and the espiguero variable (Sporophila americana). In relation to the reptiles, the lizard Sphaerodactylus homolepis, the borriguero, and the rainbow boa (Epicrates cenchria) were identified, and a great caiman (Caiman crocodylus) specimen was reported to live the contaminated waters of the Mocambo River. The herbaceous growth area is primarily occupied by seed eating birds such as the little black-blue seed eater (Volatinia jacarina), the minor little seed eater (Oryzoborus angolensis), the yellow-breasted espiguero (Sporophila nigricollis) and the variable (Sporophila americana), as well as by on reptile species, the borriguero.

Threatened Species

Panama, as well as most countries around the world has developed a series of regulations for the protection of wildlife and has become a signatory of various international conventions. National legislation dealing with threatened or endangered species includes Law 24 about Wildlife and Resolution Dir. 002-80, amongst others. This resolution considers 82 species of wildlife to be in danger of becoming extinct and in urgent need of protection.

Based on this list provided in Resolution Dir. 002-80, out of the 82 species considered to be in danger of becoming extinct. No one observed in the Site 2. Meanwhile, only nine were detected in other sites during the study. These included six mammals such as the armadillo, the titi monkey, ñeque, raccoon, gato solo and the white tail deer. As far as birds are concerned, the güichichi duck was reported; endangered reptiles included the green iguana and the caiman or babilla.

An international tool for the protection of wildlife is the Convention on International Trade of Endangered Species (CITES). This convention sets guidelines for the international trade of species of flora and fauna, and categorizes them according to their degree of threat, into three Appendices: I, II and III. Those threatened by international trade as defined in Appendix I was not detected in the Site 2. Two species categorized in Appendix II; one hummingbirds and one rainbow boa. Meanwhile, over the all sites, titi monkey is detected which is categorized in Appendix I, and nine species listed in Appendix II were reported six birds (grey falcon, grey beak toucan, and four hummingbirds) and three reptiles (green iguana, rainbow boa and the caiman). Fauna species detected during the survey are listed in Table K-98.

Table K-98: Detected Fauna Species during the Survey (Mammals)

Scientific Name	Common Name	Sampling Site					Protection Status
		S1	S2	S3A	S3B	S4	
DIDELPHIMORPHIA							
Didelphidae							
Didelphis marsupialis	*Zarigüeya común*				C		
XENARTHRA							
Megalonychidae							
Choloepus hoffmanni	*Perezoso de dos dedos*	O					
Dasypodidae							
Dasypus novemcinctus	*Armadillo de 9 bandas*	E			O		PE
PRIMATE							
Callitrichidae							
Saguinus geoffroyi	*Mono tití*	E, O					PE-AI
RODENTIA							
Sciuridae							
Sciurus variegatoides	*Ardilla gris*	E, O	O				
Echimyidae							
Proechimys semispinosus	*Rata espinosa*	O			C		
Dasyproctidae							
Dasyprocta punctata	*Ñeque*	E			C		PE
LAGOMORPHA							
Leporidae							
Sylvilagus brasiliensis	*Conejo muleto*					O	
CARNIVORA							
Procyonidae							
Procyon sp.	*Mapache*					H	PE
Nasua narica	*Gato solo*	E			O		PE
ARTIODACTYLA							
Cervidae							
Odocoileus virginianus	*Venado cola blanca*			H			PE
CHIROPTERA							
Phyllostomidae							
Carollia perspicillata	*Murciélago frugívoro*	C					
Carollia castanea	*Murciélago frugívoro*	C					
Artibeus jamaicensis	*Murciélago frugívoro*	C		C			
Chiroderma villosum	*Murciélago frugívoro*			C			
Glossophaga comissarisi	*Murciélago nectarívoro*			C	C		
Tonatia brasiliensis	*Murciélago insectívoro*	C					

Sampling Sites
- S1: Gate
- S2: Mocambo River Bridge
- S3A: Camino de Cruces National Park
- S3B: Camino de Cruces National Park
- S4: Chivo Chivo Road

Registration Methods
- C: Capture
- O: Observation
- E: Interview
- H: Tracks
- LL: Calls

Protection Status
- PE: Endangered (Res. Dir. 002-80)
- AI, AII: CITES Appendices

Table K-99: Detected Fauna Species during the Survey (Birds)

Scientific Name	Common Name	Sampling Sites					Protection Status
		S1	S2	S3A	S3B	S4	
CICONIIFORMES							
Cathartidae							
Coragyps atratus	*Gallinazo negro*	O	O	O			
ANSERIFORMES	*Pato silbador*						
Anatidae							
Dendrocygna autumnalis					O		PE
FALCONIFORMES							
Accipitridae							
Buteo nitidus	*Gavilán gris*	O					AII
Falconidae							
Daptrius americanus	*Caracara o Cao*					O	
CHARADRIIFORMES							
Jacanidae							
Jacana jacana	*Jacana carunculada*			O			
COLUMBIFORMES							
Columbidae							
Columba livia	*Paloma común*				O		
Leptotila verreauxi	*Paloma rabiblanca*	O			O		
Columbina talpacoti	*Tortolita rojiza*			O	O		
CAPRIMULGIFORMES							
Caprimulgidae							
Caprimulgus carolinensis	*Tapacaminos*					C	
APODIFORMES							
Trochilidae							
Phaethornis superciliosus	*Ermitaño colilargo*			C			AII
Damophila Julie	*Colibrí ventrivioleta*			C	C		AII
Amazilia tzacatl	*Amazilia colirufa*	C	O	O, C	C		AII
Amazilia edward	*Amazilia ventrinivosa*	C		C			AII
TROGONIFORMES							
Trogonidae							
Trogon massena	*Trogón colipizarra*			O			
CORACIIFORMES							
Momotidae							
Electron platyrhynchum	*Momoto piquiancho*			O			
PICIFORMES							
Ramphastidae							
Ramphastos sulfuratus	*Tucán pico iris*					O	AII
Pteroglossus torquatus	*Tucancillo collarejo*	O					
Picidae							
Melanerpes rubricapillus	*Carpintero coronirrojo*		O				
Dryocopus lineatus	*Carpintero lineado*	O					
PASSERIFORMES							
Dendrocolaptidae							
Dendrocincla homochroa	*Trepatroncos rojizo*	C					
Xiphorhynchus guttatus	*Trepatroncos*						
Pipridae	*gorgianteados*			C		C	
Manacus vitellinus	*Saltarín cuellidorado*		O, C	O			
Pipra mentalis	*Saltarín cabecirojo*	C					
Chiroxiphia lanceolata	*Saltarín coludo*	C					
Troglodytidae				C			
Thryothorus rufalbus	*Soterrey rufiblanco*				C		
Thryothorus leucotis	*Soterrey pechianteado*						
Sylviidae							

Scientific Name	Common Name	Sampling Sites					Protection Status
		S1	S2	S3A	S3B	S4	
Ramphocaemusmelanurus	*Soterillo piquilargo*	O, C					
Thraupidae							
Euphonia luteicapilla	*Bimbim*		O				
Thraupis episcopus	*Azulejo*	O	O		O	O	
Ramphocelus dimidiatus	*Sangretoro*	O	O	O			
Habia rubica	*Tangara coroniroja*				O	O	
Chlorothraupis carmioli	*Tagara oliva*			O			
Emberizidae							
Volatinia jacarina	*Semillero negriazulado*	C					
Qryzoborus angolensis	*Semillero menor*				C		
Sporophila nigricollis	*Espiguero ventriamarillo*	O					
Sporophila Americana	*Espiguero variable*	O	O, C				
Cardinalidae							
Cyanocompsa cyanoides	*Picogrueso negriazulado*					C	
Icteridae							
Cassidix mexicanus	*Talingo*	O	O				
Cacicus uropygialis	*Cacique lomiescarlata*					O	
Thamnophilidae							
Cercomacra tyrannina	*Hormiguero negrusco*				C		

Sampling Sites
S1: Gate
S2: Mocambo River Bridge
S3A: Camino de Cruces National Park
S3B: Camino de Cruces National Park
S4: Chivo Chivo Road

Registration Methods
C: Capture
O: Observation
E: Interview
H: Tracks
LL: Calls

Protection Status
PE: Endangered (Res. Dir. 002-80)
AI, AII: CITES Appendices

Table K-100: Detected Fauna Species during the Survey (Reptiles)

Scientific Name	Common Name	Sampling Sites					Protection Status
		S1	S2	S3A	S3B	S4	
LACERTILIA							
Gekkonidae							
Sphaerodactylus homolepis	*Gecko*		O				
Gonatodes albogularis	*Lagartija c. Naranja*	O					
Polychridae							
Anolis sp.	*Lagartija*	O	O		O		
Iguanidae							
Iguana iguana	*Iguana verde*	E					PE-AII
Teiidae							
Ameiva festiva	*Borriguero*	O	O			C	
Corytophanidae							
Basiliscus basiliscus	*Meracho*		O		O	O	
SERPENTES							
Viperidae							
Bothrops asper	*Equis*	O					
Elapidae							
Micrurus nigrocinctus	*Coral*	E				O	
Boidae							
Epicrates cenchria	*Boa arcoiris*		O			O	AII
CROCODYLIA							
Alligatoridae							
Caiman crocodylus	*Caimán o babilla*		E				PE-AII

Sampling Sites
S1: Gate
S2: Mocambo River Bridge
S3A: Camino de Cruces National Park
S3B: Camino de Cruces National Park
S4: Chivo Chivo Road

Registration Methods
C: Capture
O: Observation
E: Interview
H: Tracks
LL: Calls

Protection Status
PE: Endangered (Res. Dir. 002-80)
AI, AII: CITES Appendices

Table K-101: Detected Fauna Species during the Survey (Amphibians)

Scientific Name	Common Name	Sampling Sites					Protection Status
		S1	S2	S3A	S3B	S4	
ANURA							
Bufonidae							
Bufo marinus	*Sapo común*	O	O			O	
Bufo typhonius	*Sapito de hojarasca*	O	O				
Bufo granulosus	*Sapo*					O	
Leptodactylidae							
Physalaemus pustulosus	*Rana túngara*	O, LL	LL		LL	LL	
Hylidae							
Hyla rosenbergi	*Rana gladiadora*				C	C	

Sampling Sites
S1: Gate
S2: Mocambo River Bridge
S3A: Camino de Cruces National Park
S3B: Camino de Cruces National Park
S4: Chivo Chivo Road

Registration Methods
C: Capture
O: Observation
E: Interview
H: Tracks
LL: Calls

Protection Status
PE: Endangered (Res. Dir. 002-80)
AI, AII: CITES Appendices

Photos: Flora

Photo 1. Area without vegetation on the eastern boundary of the study area.

Photo 2. Canal Grass near the Chivo Chivo Road and PNCC.

Photo 3. The eastern portion of the study area parallel to the main roadway is dominated by herbaceous growth and dispersed trees.

Photo 4. View of disturbed forest dominated by young trees.

Photo 5. View of the River Forest of approximately 10m wide, along Mocambo River near Kuna-Nega .

Photo 6. Herbaceous growth and brushwood near river forest next to Mocambo River.

Photo 7. View of remaining disturbed forest patches located to the left of entrance.

Photo 8. View of an affluent to Mocambo River along the pedestrian crossing leading to Kuna-Nega.

Photos: Fauna

Photo 1. Amazilia Edward, Humminebird captured east of the landfill entrance.

Photo 2. Release of Bats from the nets.

Photo 3. Insect Bat Tonatia Silvícola

Photo 4. Carollia Castanea, captured near the Landfill Entrance.

Photo 5. Black-blue wide beak, common in the forest floor near Mocambo River

Photo 6. Espiguero variable, Sporophila Americana, was abundant in open areas of herbaceous growth toward the northeast limit of the study area.

Photo 7. Chiroderma Uillosum, fruit bat captured in the PNCC Forest.

Photo 8. El borriguero lizard, Ameiva Festiva, was common in brushes of the study area.

Photo 9. Long tail hermit humminebird, Phaetornis Superciliosus, was present in regeneration areas.

Photo 10. Zarigüeya, Didelphys Marsuplalis, is common in all habitats, especially disturbed areas.

Photo 11. Red Tree Climber, Xiphorhynchus Guttatus, was captured in the PNCC forest and the forest area southwest of the study area.

Photo 12. Tangara Coronirroja Habiarubica is common in the secondary forests.

Photo 13. Ñeque, Dasyprocta Punctata, was reported in disturbed areas as well as more preserved areas such as PNCC.

Photo 14. Soterrey Pechianteado o Thryothorus leucotis, common in dense forest floors and forest fringes. This specimen was captured at the limit of the PNCC and the study area.

Photo 15. The Spiny Rat, Proechimys Semispluosus, was common near the crop areas in the eastern part of the study area.

b.2 Socio-economic Environment

b.2.1 Population and Sociology

The project site has no permanent dwellings. There are, however, some makeshift shelters of cardboard and other discarded materials used by the waste-pickers who live off wastes in and around the existing landfill. This problem existed in the Panama Viejo landfill and continues in the Cerro Patacon Final Disposal Site. A study on the Waste pickers carried out in the Study estimates that there might be 450 to 600 pickers at various times in the Patacon Landfill. This social issue requires further attention by authorities concerned.

Several small communities of less than 350 people have been established on the east of the Cerro Patacon Final Disposal Site. One of these is the Kuna Nega settlement, primarily of people of native origin. It originated around 1979 and has an elementary school and several wells. A bigger community with a more recent history is located adjacent to Kuna Nega -- the Valle de San Francisco, created as part of a resettlement project in 1998. The Kuna Nega community is the closest to the landfill, at about 250 meters from the perimeter of the buffer area. In addition, Mocambo Arriba and Mocambo Abajo are other small communities nearby.

b.2.2 Historical and Cultural Background

The Camino de Cruces National Park, which is next to the Cerro Patacon Final Disposal Site, has great historic significance, because historic and cultural elements of the colonial era are found in the park. The most important is *Camino de Cruces* which was a road used between XVI and XIX century by the Spaniards to transport gold from Peru, Baja California and Chile from Panama City on the Pacific, to the Chagres River, which leads to the Atlantic, thereby crossing the isthmus. Inside the Camino de Cruces National Park, a few remnants of this historic and cultural heritage can be observed. *Camino de Cruces* starts from the Soberania National Park, continues through the forest of the Camino de Cruces National Park and ends at the Cardenas River. This route has a length of 7.7 km (See Figure K-59).

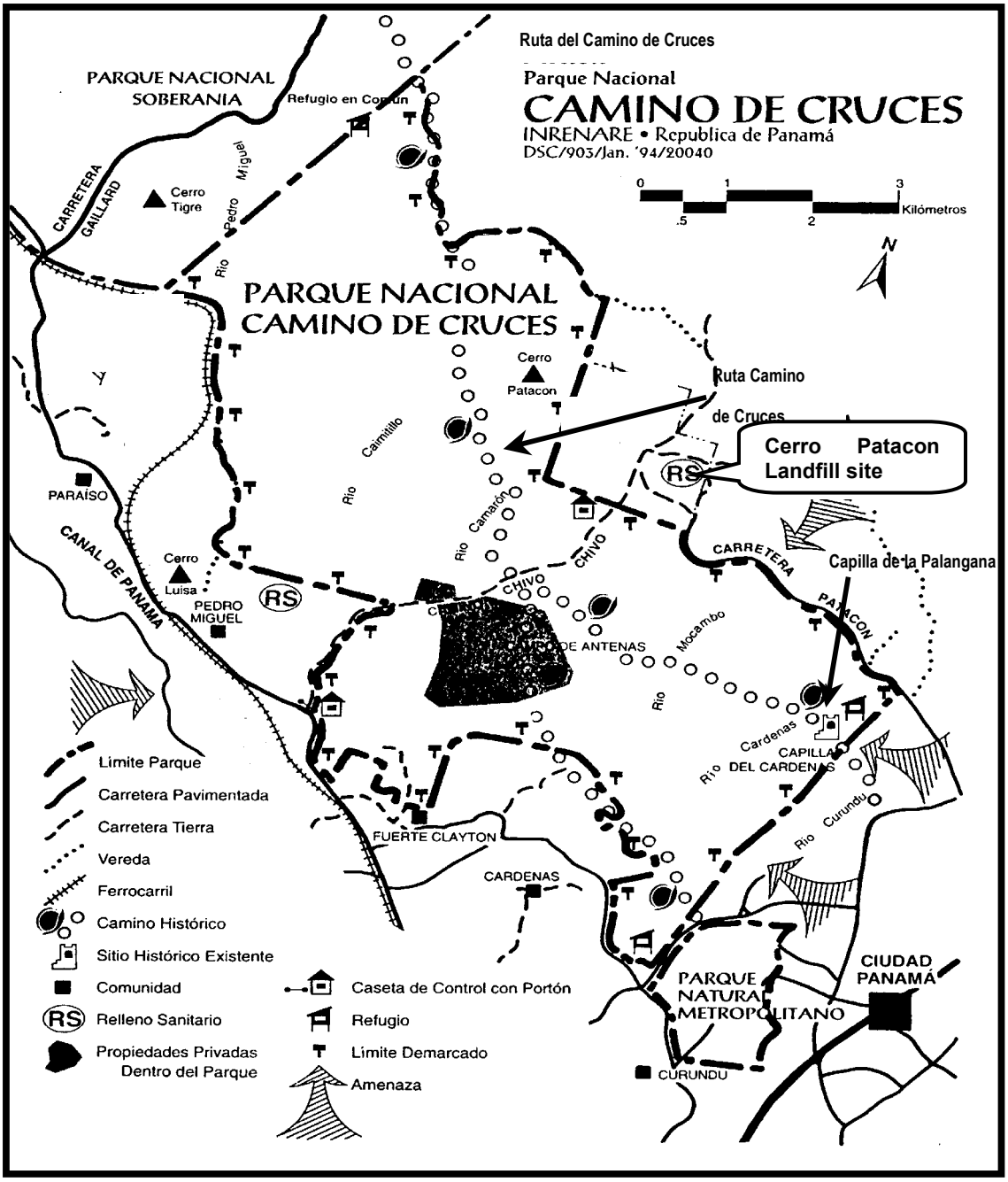

Figure K-59: Camino de Cruces

c. Identification of Environment Impacts

Approach to be Used

An environmental impact is any alteration of the environmental conditions or the creation of a set of adverse or beneficial environmental conditions caused or induced by a new action or a group of new actions (BCIE, Central American for Economic Integration).

Understanding this, the evaluation of environmental impact is aiming to identify, predict and interpret the impacts of a project in the environmental parameters that have a significant implication to the natural and socioeconomic environment.

The development works, as we are concerned, could present diverse impacts to the natural and socioeconomic environment, in stages such as land preparation, construction and operation. In relation with the project type and the characteristics of the land and environment, the impacts can be of diverse magnitude and significance.

This fact brings multiple key issues and disciplines, interactions and complexity among them. Therefore, with a purpose to identify possible environmental impacts, a checkup list is prepared (Table K-102).

The left end column shows the environmental aspects in which impacts could be observed. They are listed as to cover all possible impacts and not to omit any impact. It should be noted that the list has been elaborated for project in general, not specifically for the present project.

The table also shows the anticipated impacts, or results, of the activities of a solid waste management project during the construction and operation and after the closure of the project. In doing so, the causes and effects become explicit and impact identification is facilitated.

Following the list of environmental aspects, it is attempted to analyze the environmental impacts of the Project of the Final Disposal System. Firstly, the whole possible impacts in the list are verified briefly, or Initial Environmental Examination (IEE), then each item is ranked with from A to D depending on possibility to happen and/or significance. The results of the IEE are presented in Table K-103. Secondly, items ranked A, B or C are further investigated with the information obtained from the environmental baseline survey and other related sources.

This section presents the final evaluation of anticipated environmental impacts taking into account both results of IEE and the further investigation.

Table K-102: Possible Impacts by a SWM Project

Evaluation Aspects	Possible Impact (General guide for a SWM project)		
	During Construction	**During Operation**	**After Closure**
Socioeconomic Environment			
Resettlement	Resettlement of people living in the proposed land or on the access route.	Social instability of resettled people.	Social instability of resettled people.
Economic Activities	Disturbance of economic activities. Introduction of new employment.	Introduction of new employment.	Introduction of new activities introduced.
Transport	Increase in traffic and accidents.	Increase in traffic and accidents.	-
Public Facilities	Impacts on schools, hospitals, etc. by traffic and noise.	Impacts on schools, hospitals, etc. by traffic and noise.	-
Division of Community	Geographical separation of community or interruption of its communication.	-	Possible re-linkage of divided community.
Historical Heritage/Cultural Properties	Loss and/or devaluation of historical heritage or cultural properties such as churches, archeological remains and historical assets.	Devaluation of them by waste trailers passing nearby.	Restoration of their values to a certain extent.
Water Rights/Access Rights	Obstruction of fishing rights, water rights and rights of common access.	Obstruction of fishing rights, water rights and rights of common access.	Restoration of previously abolished access rights.
Public Health	-	Degradation of public health due to wastes fallen from the trailers, the existence of a great amount of wastes in a limited area, and/or vermin/ pathogens proliferation there. Prevention of threats to public health which could be brought by uncontrolled waste management (i.e. open dumping, no treatment or no-project option).	-
Waste (from the project)	Generation of construction wastes and debris.	-	-
Accidents/Risks	-	CH4 explosion, intrusion of CO2 into residence, refuse fires, landslides, lateral pressure on land.	CH4 explosion, intrusion of CO2 into residence, refuse fires, landslides, lateral pressure on land.
Natural Environment			
Topography and Geology	Changes in valuable topography and geology due to excavation.	-	-
Soil Erosion	Increase in soil erosion due to land preparation and/or deforestation.	-	-
Groundwater	-	Changes in quality and level of groundwater due to leachate.	Changes in quality and level of groundwater due to leachate.

Evaluation Aspects	Possible Impact (General guide for a SWM project)		
	During Construction	**During Operation**	**After Closure**
Hydrological Conditions	Changes in river discharge and riverbed condition.	Changes in river discharge and riverbed condition due to in-flow from the site.	Changes in river discharge and riverbed condition due to in-flow from the site.
Coastal Zone	Impacts on coastal environment.	Impacts on coastal environment.	Impacts on coastal environment.
Fauna and Flora	Obstruction of breeding of natural species and/or extinction of them due to interruption or loss of their habitats.	Obstruction of breeding of natural species and/or extinction of them due to interruption by traffic, noise and/or presence of humans.	Introduction of new habitat.
Meteorology	Changes in temperature, wind direction and/or intensity, etc.	Changes in temperature, wind direction and/or intensity, etc.	Changes in temperature, wind direction and/or intensity, etc.
Landscape/ Aesthetics	Changes in landscape.	Changes in aesthetic values due to the existence of the facility.	Changes in aesthetic values due to the existence of the facility.
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 tracks, the landfill gases and/or smoke/dust from site operation.	-
Water Pollution	Deterioration of water quality of surface water and/or groundwater due to the inflow of sand/silt from land preparation work.	Deterioration of water quality of surface water and/or groundwater due to the inflow of sand/silt and leachate from the site.	Deterioration of water quality of surface water and/or groundwater due to the inflow of leachate from the site.
Soil Contamination	-	Contamination of soil by leakage of leachate.	Contamination of soil by leakage of leachate.
Noise and Vibration	Noise and vibration caused by the construction operation and/or the construction tracks.	Noise and vibration caused by the waste trailers and/or landfill site equipment.	-
Land Subsidence	Land subsidence due to land deformation.	-	-
Offensive Odor	-	Odor caused by scattered wastes from waste trailers and/or wastes accumulated at the site.	-

Table K-103: Results of Initial Environmental Examination on the Project of Final Disposal System

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.

Evaluation Items	Rank
Socioeconomic Environment	
Resettlement	D
Economic Activities	D
Transport	D
Public Facilities	D
Division of Community	D
Historical Heritage/ Cultural properties	C
Water Rights/ Access Rights	D
Public Health	B
Waste (from the project)	D
Accident/Risks	B
Natural Environment	
Topography and Geology	C
Soil Erosion	B
Groundwater	B
Hydrological Conditions	B
Coastal Zone	D
Fauna and Flora	B
Meteorology	D
Landscape/ Aesthetics	B/A
Pollution	
Air Pollution	B
Water Pollution	B
Soil Contamination	B
Noise and Vibration	D
Land Subsidence	D
Offensive Odor	B

c.1 Socioeconomic Environment

c.1.1 Resettlement

Evaluation: No or insignificant impact.

The project site has no permanent dwellings. There are, however, some makeshift shelters of cardboard and other discarded materials used by the waste-pickers who live off wastes in and around the existing landfill. A study on the Waste-pickers curried out in the Study estimates that there might be 450 to 600 pickers at various times in the Patacon Landfill. This social issue requires further attention by authorities concerned.

c.1.2 Economic Activities

Evaluation: There is an impact on economic activities of the waste-pickers and junk dealers.

The Cerro Patacon Final Disposal Site is already used for solid waste disposal. Further disturbance of economic activity is not expected. There are, however, economic activities of waste-pickers and junk dealers who are living off wastes as mentioned above. Their activities, of course, are health damaging as well as give adverse effects on the landfill operation. Therefore, such activities are usually not expected in sanitary landfills.

c.1.3 Transport

Evaluation: No further impact

The area is already used for landfill operations, then, there is traffic of waste collection vehicles. Slight traffic increment will be due to additional vehicles which will cover population increment.

c.1.4 Public Facilities

Evaluation: No impact

There are no public facilities in the project site. The closest community that has public facilities is well far, about 250m, from the project site.

c.1.5 Division of Community

Evaluation: No impact

The area is already used for landfill operations. No community exists in the area.

c.1.6 Historical Heritage/ Cultural properties

Evaluation: There might be historical heritage

There is a potential that archeological remains might be found, because such discovery is common in the region, especially around *Camino de Cruces* that passes through the Camino de Cruces National Park. In the Cerro Patacon Landfill Site, there has been no report of discovery of such archaeological remains.

c.1.7 Water Rights/ Access Rights

Evaluation: No impact

The site is owned by Panama Inter-Oceanic Region Authority (ARI). Neither water rights nor access rights is associated with the land. Therefore, there is no chance to affect them.

c.1.8 Public Health

Evaluation: Expected impacts are controllable and large benefits to the public health should be brought.

Public health might be affected by the project for the following reasons.

- Waste scattered from the waste trailers, which deliver waste from its origins to the plant due to the mismanagement of waste delivery.
- Offensive odor emitted from putrescible waste.
- Proliferation of vermin and/or pathogens attracted to food waste.
- Dust caused by waste tipping, trailers movement on site, or from cover soil.

However, the mentioned above is controllable with proper landfill operation. That is, use of compactor trucks minimizes littering waste, daily soil cover is the most effect to prevent offensive odor and proliferation of vermin and/or pathogens, and water spray can avoid dust.

Sanitary landfilling is the best available option for waste disposal in terms of pubic health and brings large and long-term benefits to the citizens.

c.1.9 Waste (from the project)

Evaluation: Negative and long-term impacts could be anticipated, but they will be well controllable.

The project will be accompanied with excavation work. Soil excavated will be used for embankment construction of the landfill and covering waste. However, excess soil is expected to be left and stored at the northwest of the project site. The area where the excess soil is stored is dominated with herbaceous plants, and there is no diversity in vegetation. Therefore, there will be not significant adverse impacts. Besides, proper management, e.g., proper filling up manner to make the stored soil stable, construction of ditches to drain rainwater and planting to avoid erosion, will minimize the impacts.

c.1.10 Accident/Risks

Evaluation: Negative and long-term impacts could be anticipated, but they will be well controllable.

Landfill operation can lead to an unexpected incident due to (i) problematic site management, (ii) gas generation.

i) Problems of Management

Incidents caused by careless site management can be expected during both the construction and operation phases.

During construction, the operation of construction equipment and machine such as dump trucks, bulldozers and loaders may be a danger to the site workers. Instructing good site operation to the workers, control of their movement and appropriate site supervision by experienced personnel minimize the potential risk.

During the operation, waste itself can pose serious risk. Hazardous, chemically active, and/or radioactive wastes are particularly dangerous for the workers and could bring long term risks open to the general public. Since the landfill to be constructed is not supposed to accept those wastes, proper waste disposal manner will be thoroughly instructed to the generators of such waste. At the site, waste is inspected periodically on arrival, and visually monitored by the site workers at the tipping front.

Improper landfilling may cause landfill slope slides that may inflict injury on workers on the site. This can be avoid with proper compaction of waste, application of proper slope degree, slope protection with greening, construction of drainage, and so forth.

ii) Gas Generation

The biological process taking place in a landfill with municipal solid waste results in the generation of so-called "landfill gas" or "biogas" which contains CH_4, CO_2, and small quantities of CO, N_2, O_2, ammonia, sulfide and other trace gases. Primary concern regarding the biogas is CH_4 and CO_2. Both of these gases (CH_4 and CO_2) contribute to the greenhouse effect. Currently, there is a project under consideration to produce electricity from biogas; however, in the absence of this project, the global effect of the emission of both gases can be reduced by oxidizing (burning), at the evacuation extreme of the pipe, the CH_4 and convert it into CO_2. It is estimated that the Global potential warming of CH_4 is 21 higher than that one of CO_2 (IPCC, 1996). Additionally, it has to be considered that the proportion of these two gases varies with the composition of waste and the age of the landfill, but in general, CO_2 becomes the principal gas (about 60% on dry volume bases) in the earlier stage of anaerobic decomposition. After this, CH_4 exceeds CO_2, remaining about 60% for a fairly long period.

CH_4 is, if present in the air in concentrations between 5 and 15 %, explosive. Within a landfill, oxygen depletion acts as an impedance of CH_4 explosion. Once CH_4 migrates to the outside of the landfill and meet with air, however, there is a large risk of explosion.

CO_2, being a heavier than air, tends to migrate downwards and remain in the lower portion of the landfill for long time. When there is a chance of migration and contact with groundwater, it will be partly solved or precipitated as calcium carbonate on soil. However, if it finds a pathway to enclosed sections (houses and/or buildings), CO_2 will be concentrated up to over 0.5% and it is asphyxiant.

Migration pathways for those gases can be geological formation (fissures, joints, caves, etc.) and man-made structures (boreholes, wells, sewer, etc.), and also can be found on site such as monitoring sumps, ventilation facilities and cracks created by settlement at site margins.

The proposed landfill design incorporates passive ventilation facilities in order to prevent unexpected gas migration. As far as the ventilation is exercised in a controlled manner, landfill gas will be trapped and dispersed before migrating and risks due to the landfill gas will be minimal.

Besides, due to the presence of the geomembrane liner on the bottom of the landfill, the chance of biogas migration through underground pathways is also minimal. Further, as for CO_2, there is a sufficient distance between its source and the residential area, which is an anticipated target of CO_2 impact.

It should be stressed that landfill gas formation generally lasts for nearly 15 years or more after the site closure, depending on the decomposition speed of waste. Therefore, ventilation facilities are kept maintained and regular monitoring of gas composition is carried out.

c.2 Natural Environment

c.2.1 Topography and Geology

Evaluation: Long-term impacts could be anticipated, but they will be well controllable.

Excavation works are required to construct the new landfill. There is a hill at height of about 100m above sea level. The hill will be excavated to make the landfill. However, a new hill that is almost as same height as the existing hill will be created with waste.

c.2.2 Soil Erosion

Evaluation: Negative impacts could be anticipated, but they will be well controllable.

Vegetation in the project site will be removed for the landfill construction as well as for obtaining cover soil. The bottom of the landfill covered with liner and operation will start right after completion. Then, negative impact will be minimal. However, it should be noted that the rainfall in the area is so intense that careful attention to soil erosion is indispensable.

c.2.3 Groundwater

Evaluation: Negative and long-term impacts could be anticipated, but they will be well controllable.

The possible environmental impact on groundwater is twofold: change in the groundwater table level and change in groundwater quality.

i) Groundwater Table Level

At a part of the project site, groundwater level is shallow so that the excavation may reach to it. The groundwater is considered as fissure water as the rock has many cracks according to the results of geological survey. The design of the landfill includes a drainage system for groundwater, consequently, the groundwater table could be affected when the excavation reaches that level and a drainage system is introduced. However, this would not cause serious impacts as the groundwater will continue to flow out to the Mocambo River at a place close to the project site, and currently there is no use of the groundwater in and around the project site.

ii) Groundwater Quality

When water passes through waste which is under biological decomposition, a wide variety of substances present in waste, of which heavy metals are of particular concern, will be dissolved into water. As the decomposition of relatively young waste produces carbon dioxide and organic acids, pH of water drops and toxic constituents, particularly heavy metals, become readily soluble. The impact of leachate on underlying groundwater should be considered in terms of quantity and quality of leaked leachate.

Rainfall is principal origin of leachate, but its percolation into the waste is considered to be small. This is because cover soil will act as waterproofing. Then, leachate generation amount is controlled in first place.

The new landfill has seepage control lining system consisting of soil, geotextile, synthetic liner and sand layer in order to avoid the leachate leaking into the groundwater. Besides the lining system, leachate collection system will collect and transport leachate to the treatment facility. Therefore, the leachate will not stay in the landfill for a long period so that the chance of leachate leaking is decreased.

c.2.4 Hydrological Conditions

Evaluation: Positive impact on water flow of river

Mocambo River flows from the northwest to the southeast of the project site. The boundary of the project site will be basically kept 50 m away from the river. However, at the east end of the project site the river is meandering and often changes its flow. The project will improve the part of river and make the flow stable.

c.2.5 Coastal Zone

Evaluation: No impact

This is not relevant, since there is no coast near the site.

c.2.6 Flora and Fauna

Evaluation: Negative and short/mid-term impacts could be anticipated, but they will be remedied at the end.

Flora

The natural condition in the site, where the landfill in question is to be established, will be altered. The alteration will be in general observed by the reduction of the vegetable cover and change of the composition of flora species, which will be incurred at different stages by different activities.

The causal project activities and their effects will be as follows.

- Land preparation will eliminate the vegetable cover which may include ecologically valuable species.
- Land preparation will eliminate the vegetable cover which was placed with a purpose to prevent a storm dust, and re-introduce that problem.
- Traffic during the construction and operation along the access road may produce suspended particles and dusts and affect plant growth.

As for the first issue, the vegetation in the project site is fairly disturbed, according to the Environmental Baseline Survey only one plant which may be categorized in threatened species defined in Panama was found. Meanwhile, vegetations around the Cerro Patacon Final Disposal Site have much more importance in view of ecology. Especially, Camino de Cruces National Park maintains diversity in flora. Therefore, further development of the project site will not cause serious impacts as a whole.

Regarding the second, it should be noted that the project site is currently excavated to obtain soil for covering waste in the existing landfill. The increase in the probability of storm dust due to the vegetation elimination is deemed to be small. Further, the land is eventually covered with impermeable liners which will shut out dusts.

Regarding the third, impacts of particles and dusts would be small because the access road has been used for transportation of waste and soil.

On the other hand, the project is aiming to establish a new green area after the closure. Since a part of the present project site has been excavated, the introduction of plants will be a long-term positive impact.

Fauna

The implementation of the project inevitably disturbs part of habitat of wildlife by land occupation and employment of heavy machinery.

Likewise flora, variety of fauna species in the project site is poor. The surrounding of the project site, especially the Camino de Cruses National Park, has much more diverse fauna. Therefore, it is considered that the fauna species in the project site will move to the surrounding.

c.2.7 Meteorology

Evaluation: No impact.

The scale of the project is not large enough to cause any change in meteorology.

c.2.8 Landscape/ Aesthetics

Evaluation: Positive impact in a long-term.

The present project site has a hill having height of about 100 m above see level. At present, this hill is scraped down to obtain soil for covering waste, then, it will be further excavated to construct the new landfill. During construction and operation, the scenery of the site will be largely changed. However, after completion of the operation, another hill made up with waste and covered with green will appear. This will improve the landscape of the site at the end.

c.3 Pollution

c.3.1 Air Pollution

Evaluation: Insignificant negative impacts anticipated, but prevented by control.

Air pollution may be caused by two factors: traffic and site operation.

i. Air Pollution by Traffic

It is generally known that vehicle transportation pollute the atmosphere due to the exhaust gas containing SOx, NOx and CO. The presence of these may increase the occurrence of respiratory diseases or eye irritation in population and damage vegetation.

Since the project site is in the present final disposal site, traffic will only increase due to population growth as time passes, such increment of traffic will be insignificant. Furthermore, the project site is well far from the community that is closest to the site. Pollutants emission due to the project will be only slight to the community.

ii. Air Pollution by Operation

Air pollution caused by landfill operation is attributed to the generation of noxious gases and dust.

Regarding the former, the concern is twofold. One is major biogas components, namely methane and carbon dioxide, and already discussed earlier. The other is about trace gases with offensive odor, which will be independently considered later.

In respect of dust problem at the site, it is anticipated that dust will be raised at the tipping front, from the soil cover, and/or from the inner roads when vehicles run. For the first issue, it will be more or less inevitable due to the nature of the operation, but the problem is very local and the impact can be minimized by workers' using appropriate masks. Dust from the soil cover can be controlled by spraying water.

c.3.2 Water Pollution

Evaluation: Negative and possibly long-term impacts anticipated but to be well controlled.

Water pollution could be found in groundwater and surface water. As for groundwater, this issue is well discussed before. The seepage control lining system will prevent the groundwater from being contaminated with leachate. Then, collected leachate will be treated in the facility and discharged to Mocambo River. The effluent will meet with the standards established in Panama.

As for the surface water, runoff from outside will be collected by the drainage system that will be constructed in the project, then no entrance of runoff from outside into the new landfill is expected. Waste will be covered with soil daily, therefore, rainwater will not contact with waste and not be contaminated. Furthermore, the final cover after completion of the landfill will be employed and it will be firmly compacted not to be eroded. It should be noted that proper management is important in order to make the daily cover soil and the final cover function sufficiently.

c.3.3 Soil Contamination

Evaluation: Negative and possibly long-term impacts anticipated but to be well controlled.

In SWM projects, issue of soil contamination is chiefly related to leachate. If the leachate leaks to the ground, soil contacted with leachate will be contaminated. However, the project will employ the seepage control lining system, which prevents soil from contaminated by leachate.

c.3.4 Noise and Vibration

Evaluation Insignificant negative impact anticipated, but controlled.

There is a sufficient distance from the site to the adjacent population. Therefore, there will no impact by noise or vibration on residential areas.

However, noise and/or vibration caused by heavy machinery might have health effects on the workers at the work front. An appropriate health control for them should be practiced.

c.3.5 Land Subsidence

Evaluation *No impact.*

According to the geological survey, the rock lays down under the project site. Therefore, land subsidence is not anticipated.

c.3.6 Offensive Odor

Evaluation: *Negative impact on limited recipients (site workers) and to be minimized with care.*

Production of offensive odor from organic waste is anticipated. Daily soil cover is very effective to prevent this problem. The pilot project of landfill operation improvement carried out in the study well proved this matter.

Offensive odor may also result from the production of landfill gas. However, landfill gas should not cause a significant odor problem as they will be ventilated in a controlled manner.

d. Measures of Prevention and Mitigation of the Anticipated Impacts and Monitoring Program

The previous section describes the possible causes and effects on the environment given by the landfill development. As mentioned briefly, the anticipated adverse impacts can be prevented or minimized with countermeasures. This section discusses such measures further.

Meanwhile, during operation and post closure of the landfill, it is important to monitor the conditions of the landfill, as biological reaction proceeds inside and quality of leachate and landfill, which are significant pollutants generated from waste disposal, changes as time go on. Therefore, a monitoring program is proposed at the end of this section.

d.1 Countermeasures

d.1.1 Control of Waste Access

Effect: *Prevention of landfill of unintended waste.*

Ensured by: *Instruction to the workers.*

With a purpose to avoid the entrance of solid wastes which should not be disposed of at the landfill because of their hazardous characteristics, a routine visual inspection will be made on two occasions.

In the inspection on the arrival of the collection vehicles at the weighbridge, the following is observed:

- Type of vehicles (origin, relevant authority)
- Type of area from which waste was collected.
- Type of waste (either normal household waste, liquidish, powdery, oily, or any other).

In the inspection at the work front during the waste unloading:

- Type of waste.
- Presence of dangerous materials (sharp metal, glass, etc.).

In the event of identifying suspicious waste, the following actions are taken.

- Stop the disposal of the concerned waste.
- Obtain general data of the vehicle and the waste (origin, place from which waste was collected, character and weight of the waste, etc.).
- Direct the waste to personnel of appropriate responsibility.
- Follow the relevant laws on penalty.
- Consider the preventive measures to be taken.

The site workers are instructed in advance how to carry out inspection, together with the knowledge about what kind of risk is accompanied by what type of waste.

d.1.2 Control of Vehicle Flow

Effect: *Avoiding congestion of collection vehicles and traffic accidents.*

Ensured by: *Supervision over vehicle movement and instruction to the drivers.*

Inside and around the working cells, the movement of the collection vehicles and other machinery is controlled to be one-way and at low speed by signs, instructions to the drivers and operators in advance and visual supervision by site managers.

d.1.3 Signboards

Effect: Minimizing risks.

Ensured by: Inspection of signboards

Inside the sanitary landfill, it will be indispensable to provide an indication system, basically for security of traffic (see above) and site workers to prevent accidents. Indications for the workers include “no smoking”, “use of protection”, “no enter”, “attention to vehicles”, and others.

The system should be based on the nationally or internationally accepted symbols using standard figures and colors. The indication are clearly expressed on the signboards, which are made of resistant materials. They are placed at strategic points which are perfectly visible at convenient distances but should not obstruct site operation. For this purpose, some will be fixed, while the other will be mobile.

Appropriateness of their expression, location and visibility of the signboards is regularly checked.

d.1.4 Daily Soil Cover

Effect: *Prevention of odor emission, control of noxious vermin and pathogens, and control of rainfall infiltration.*

Ensured by: *Supervision of qualified engineers over operation and scheduled supply of material.*

At the end of day, waste is covered with soil having thickness of about 15cm. By doing so, offensive odor emission is cut off, the development of disease-causing vermin and pathogens is prevented, and rainfall infiltration into the waste is minimized, hence so is the leachate generation.

d.1.5 Impermeabilization

Effect: *Prevention of groundwater intrusion into the waste, groundwater and soil contamination with leachate and migration of landfill gas.*

Ensured by: *Inspection of liner quality, supervision of qualified engineers over secured implementation and water quality monitoring.*

The seepage control lining system is laid over the cells before waste is landfilled. Therefore, (i) groundwater does not intrude into the waste, thus leachate generation amount is reduced, (ii) the leachate is not allowed to flow out of the cell, and (iii) migration pathway of landfill gas is intercepted. The anticipated impacts caused by leachate and landfill gas, both of which are in fact the principle concerns of waste landfill, are significantly minimized, and it can be concluded that the employment of the seepage control lining system is a fundamental element of the proposed design.

Prior to the construction, land preparation is carried out by removing rocks or plants which might affect the liner. Before being employed, the liner is thoroughly inspected to see if there is a fault. Whether the seepage control lining system is functioning or not is monitored by regular analysis of groundwater outside the landfill (see later).

d.1.6 Leachate Treatment

Effect: *Prevention of surface water contamination.*

Ensured by: *Supervision of qualified engineers over design, construction, secured implementation and water quality monitoring.*

The treatment facility is installed in order to treat leachate generated in the landfill. The effluent from the facility will meet with the standards established in Panama. Then, the effluent will not contaminate the surface water body, Mocambo River.

Treatment facilities, in general, are required to be well monitored and often adjusted in order to secure proper operation which can be ensured only qualified engineers.

d.1.7 Landfill Gas Control

Effect: *Prevention of unexpected landfill gas migration.*

Ensured by: *Supervision of qualified engineers over design and construction of ventilation wells and monitoring of wells' function.*

When biogas is generated, the air pressure becomes high, and acts as a driving force of gas movement. Therefore, the gas ventilation pipes, which have lower pressure inside of them than inside the landfill itself, smoothly draw and vent gas.

Without such method, gas pressure inside the landfill becomes uneven. It can be partly so high that gas is forced to be concentrated in migration pathways of limited number. Consequently, the risk caused by gas migration, i.e. explosion by methane and asphyxiation by carbon dioxide, is raised.

In the ventilation pipes, gas composition is monitored in order to see whether the ventilation system is functioning well.

d.1.8 Reforestation

Effect: *Avoidance of loss of cover soil, increase in green area, and introduction of a new habitat for wildlife.*

Ensured by: *Supervision of experienced personnel over reforestation planning and implementation.*

After the closure, the landfill surface is planted. The vegetation cover will reinforce the stability of the cover soil, avoiding soil loss. It also provides a new green area which attracts wildlife. The reforestation plan is executed under the supervision of experienced personnel.

d.1.9 Access Control

Effect: *Avoidance of accidents.*

Ensured by: *Instruction to the guards and inspection of the signboards.*

Entrance of the general public is restricted by control of the guards and signboards at the entrance of the access road. The duty is instructed to the guards and the signboards are inspected regularly to make sure that they are visible by people.

d.1.10 Safety Surveillance

Effect: *Prevention of risk for the workers.*

Ensured by: *Instruction to the workers and site supervisors.*

Safety manuals should be prepared which indicate actions to be taken in case of fire, injure, and other contingencies affecting the workers' safety.

Through the manual, and also oral instructions, the workers are urged to use appropriate clothes to protect themselves from injure, dust, heat, offensive odor, vermin/pathogens and any other health danger raised at the landfill. Such clothes will include gloves, masks, and boots.

d.2 Monitoring Program

Monitoring program is undertaken with three purposes. One is to understand the ongoing activities inside the landfill so that the prediction of the impacts and planning of next actions to be taken are possible. Another is to ensure that the countermeasures are working properly, in other words, no contaminants that may affect public health and the surrounding natural environment are escaped outside the landfill. Finally, the collected data are to be interpreted so that they are reflected to the future landfill plans. Elements to be monitored are elevation of lifts, groundwater, surface water, leachate and landfill gas. The monitoring program is shown in Table K-104.

Monitoring of Waste Decomposition

Monitoring settlement of the landfill is important in this site. The settlement will be caused by decomposition. Data obtained by this monitoring can be useful for the future landfill operation and land use after closure.

In addition to the monitoring of settlement, leachate and landfill gas quality, which can show the progress of waste decomposition, are also monitored.

Monitoring of Environmental Quality

This monitoring will be conducted in view of environmental protection. It is recommended to monitor the quality of:

- Groundwater at upstream and downstream of the site.
- Effluent from the leachate treatment facility

No evidence of groundwater contamination with leachate implies that the seepage control lining system is working adequately. This further suggests that landfill gas migration through the liner is unlikely. Meanwhile, quality of effluent from the treatment facility will tell if it works properly.

Table K-104: Monitoring Program

Subject	Monitoring item	Frequency (per year)
Settlement	Elevation of lift(s)	1
Landfill gas	Temperature	2
	CH_4	2
	CO_2	2
	N_2	2
	O_2	2

Monitoring item	Frequency (per year)		
	Leachate	Groundwater	Effluent
Temperature	2	1	1
Color	2	1	1
pH	2	1	1
BOD_5	2	1	1
COD	2	1	1
T-N	2	1	1
T-P	2	1	1
Cl^-	2	1	1
CN	1	1	1
Cd	1	1	1
Cu	1	1	1
Pb	1	1	1
Cr^{+6}	1	1	1
Hg	1	1	1
As	1	1	1

e. Conclusion

The previous chapters discussed the benefits brought by the project, its importance in the urban society, and the anticipated influences of the modification of the natural and socioeconomic environment.

In concluding impact assessment, it should be emphasized that the impact is a function of the character of recipients and the type of activities. If the recipients are vulnerable or sensible, they can be affected however small the intended activities are, and vice versa. Therefore, impacts cannot be assessed by looking at only one side: both the character of recipients and the type of activities have to be taken into account.

The recipients will be, in the present case, the environment, people, and the metropolitan society. The vulnerability or resistance of the environment at the site was assessed by the environmental baseline survey and other relevant information. It was inferred that the site is not particularly susceptible to the human interventions. Recipient people are at a distance from the site, which considerably reduces their vulnerability. Since all members of the metropolitan society produce wastes, it will be directly influenced by the project.

On the other hand, the activities at the site involves a number of preventive actions against negative impacts, such as the seepage control lining system, construction of leachate collection and treatment facilities, maintaining of buffer zone to Mocambo River, site management measures as well as the implementation of monitoring programs will minimize threats on the human health and the risks of environmental contamination in the site and its influence area. Thus, the negative influence for the environment and people is largely suppressed. Besides, since environmental enhancement by reforestation after closure is also contemplated, the overall influence could be positive. On the other hand, for the society, the principle activity, i.e. disposal of municipal waste, is fundamental and indispensable and should have an invaluable influence.

In conclusion, the impact as a result of the character of recipients and the type of activities is, therefore, not significantly negative but could be even beneficial for the environment and people, and highly positive for the society.

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K.6 Project Evaluation

This section evaluates viability of the priority projects, the Final Disposal Project and the Transfer and Transport Project, from technical, institutional, social, environmental, financial and economic viewpoints.

K.6.1 Technical Evaluation

Technical evaluation herewith gives an assessment whether or not these priority projects are technically practicable, with reference to the present technical capabilities of DIMAUD and technology transfer carried out through the Study.

a. Final Disposal Project

The present landfill of Cerro Patacon has liner system and leachate treatment facilities. All these facilities have been planned, designed and operated by DIMAUD (formerly DIMA) and private companies in the Panama District.

This project will be implemented by the private sector under concession contract. In this situation, roles of DIMAUD are to manage the contract and supervise the operation in order to secure proper final disposal. Knowledge and experiences in construction and operation of sanitary landfill are required for acting these roles. DIAMUD has learned such knowledge and experiences so far through construction and operation of Etapa 1 and 2. Besides, the Landfill Operation Improvement Pilot Project well transferred technologies regarding landfill operation to DIMAUD.

Consequently, it is evaluated that the society of the Panama District has enough capability to design and construct sanitary landfill facilities, and DIMAUD will be able to ensure proper operation of sanitary landfill with their capabilities.

b. Transfer and Transport Project

A transfer station will be constructed in the east of the Panama District, then 65m^3 tractor and trailer will be employed as waste transport equipment, i.e., the project consists of the transfer station and transport. Introduction of this transfer and transport system will be the first case in the Panama District.

Therefore, the construction of the transfer station will of course be the first case. However, ordinary construction materials and general-purpose construction equipment can set up the transfer station. The construction situation in the Panama District well proves its capability to be able to do so.

$85yd^3$ trailers, which has about 20 ton of maximum loading capacity, will be installed for the first time in the waste management in Panama District. However, 20ton class trailers and tractors are widely used in other physical distributions and their know-how will be applied to O&M of the $85yd^3$ trailers.

Therefore, the Transfer Transport System is judged practicable considering the present technical level of the society of Panama District.

K.6.2 Institutional Evaluation

DIMAUD will be required to manage and supervise concession contract(s) with the private company for implementation of the priority projects. Therefore, the Study provides a guideline to prepare appropriate TOR for the contract(s).

Meanwhile, the M/P gives a concrete direction with various plans and suggestions to strengthen its capability (Institutional Capacity Building).

Consequently, it is evaluated that DIMAUD will be able to implement the priority projects with the institutional plan proposed in the M/P and the TORs.

K.6.3 Social Evaluation

a. Final Disposal Project

It is thought that the project would take away means of living from the waste-pickers and environmental impacts on the neighbouring communities.

The issue of waste-pickers is inevitable for modernization of MSWM. DIMAUD and organizations concerned should take measures not to increase the number of waste-pickers and to create job opportunities. MRF proposed in the M/P may give job opportunities to the waste-pickers where they can get away from the illegal waste picking on the landfill, and move to legal material recovery works with better conditions and improved social positions.

The conceptual design of the priority projects was formulated with taking into account mitigation measures proposed in the EIA against anticipated environmental impacts. Therefore, environmental impacts on the neighboring communities will be enough mitigated.

b. Transfer and Transport Project

The Transfer and Transport Project may cause negative environmental impacts on communities around the transfer station and positive impacts induced by efficient use of collection vehicles.

Regarding the negative impacts, selecting appropriate site and setting up sufficient buffer zone will mitigate them.

Efficient use of collection vehicles will bring about improvement of collection service such as periodical and punctual waste collection, and improve working conditions of workers such as reduction of working hours.

K.6.4 Environmental Evaluation

a. Final Disposal Project

The EIA evaluated that the project has a potential to cause negative environmental impacts, however, such negative impacts can be minimized by environmentally appropriate design, construction and operation with taking into account the proposed countermeasures. Meanwhile for the whole Panama District, the project bring about positive environmental impacts.

b. Transfer and Transport Project

EIA is not carried out for the project, because a site for the transfer station is not confirmed. However, Initial Environmental Examination was carried out, which provides information of potential environmental impacts caused by introduction of a general transfer and transport system.

The environmental impacts that may be caused by the project will be minimized with environmentally appropriate design, construction and operation with taking into account issues pointed out by the IEE.

K.6.5 Financial Evaluation

It was found that large deficits in DIMAUD's cash flow would happen in case that the priority projects are carried out directly by DIMAUD. Then, it was recommended for consigning the implementation of the priority projects to the private sector under concession contract in order to overcome the financial deficits.

From a viewpoint of DIMAUD, it was evaluated in the M/P that such concession contract would be financially feasible. The financial analysis conducted in the F/S also concluded that

the concession contract would be financially feasible for contractor(s) as shown in Table K-105.

Table K-105: Results of Financial Analysis

Case	FIRR (%)
Landfill	5.2
Transfer transport system	3.5
Landfill and Transfer transport system	4.9

The FIRRs in the table do not exceed annual interests set by commercial banks in Panama, that is about 9.5%. However, those FIRRs are over 1.8% of annual interest used in the Study, which takes into consideration risks on interest rates set by international financial institutions, such as LIBOR.

Consequently, it is evaluated that the implementation of the priority projects will be financially feasible under concession contract. International tender should be held, in which private companies that are capable to procure the international fund can participate.

K.6.6 Economic Evaluation

Willingness to Pay (WTP) of the citizens to MSWM obtained from POS is considered as benefit, as well as for the economic evaluation of the M/P.

a. Final Disposal Project

a.1 Benefit

The WTP to MSWM is U$77.02/ton as shown in the M/P economic evaluation. Benefits only for the final disposal, or U$18.68/ton is calculated by multiplying U$77.02/ton by the proportion of the final disposal cost to the total MSWM costs as shown in Table K-106. Then, total benefit of U$105,717,000 by 2015 is obtained by multiplying U$18.62/ton by waste amount to be disposed of in Etapa 3.

Table K-106: Benefit of Landfill

Item	Total cost (U$1,000)	Ratio (%)	Benefit (U$/ton)
Existing cost (exc. landfill base cost)	333,396	69.22	53.31
Separate collection	9,498	1.97	1.52
Final Disposal	**116,797**	**24.25**	**18.68**
Transfer transport system	13,279	2.76	2.13
MRF	8,649	1.8	1.38
Total	481,619	100	77.02

a.2 Economic Evaluation

Table K-107 presents 1.215 of Benefit-Cost Ratio (B/C) and 8.9% of Economic Internal Rate of Return (EIRR) resulted from calculation with the benefit and costs required for the project. Consequently, it is evaluated that the project will be economically feasible.

Table K-107: Cost and Benefit (Final Disposal Project)

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Cost	Investment (Exc. TAX 5%)	134	9,087	291	19,720	325	21,944	8	484	0	0	0	0	51,993
	O & M	0	2,946	2,946	2,946	2,946	2,946	2,946	2,946	3,604	3,604	3,604	3,604	35,038
	Total	134	12,033	3,237	22,666	3,271	24,890	2,954	3,430	3,604	3,604	3,604	3,604	87,031
Benefit	Disposal amount (ton/year)	0	0	262,276	535,966	551,004	567,393	582,102	597,943	613,930	631,414	649,189	668,096	
	Willingness to pay (U$1,000)	0	0	4,899	10,012	10,293	10,599	10,874	11,170	11,468	11,795	12,127	12,480	105,717
	Balance	-134	-12,033	1,662	-12,654	7,022	-14,291	7,920	7,740	7,864	8,191	8,523	8,876	
													EIRR	**8.9%**
													B/C	**1.215**

b. Transfer and Transport Project

b.1 Benefit

WTP of U$53.31/ton for the existing SWM service excluding the landfill can be distributed for each component as shown in Table K-108. Then, U$30.23/ton is obtained as WTP for the Transfer and Transport Project by adding U$28.10/ton of WTP for the existing collection service (See Table K-108) with U$2.13 of WTP for the Transfer and Transport (See Table K-106).

Table K-108: WTP for the Existing SWM Service (ex. Landfill)

Item	Total cost (U$/ton)	Ratio (%)	WTP (U$/ton)
Administration	9.088	20.56%	10.95
Collection	23.303	52.71%	28.10
Maintenance	3.438	7.78%	4.15
Sweeping	7.037	15.92%	8.49
Landscaping	1.340	3.03%	1.62
Total	44.206	100.00%	53.31

b.2 Economic Evaluation

Table K-109 presents 1.251 of Benefit-Cost Ratio (B/C) and 17.5% of Economic Internal Rate of Return (EIRR) resulted from calculation with the benefit and costs required for the project. Consequently, it is evaluated that the project will be economically feasible.

Table K-109: Cost and Benefit (Transfer and Transport Project)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Waste amount (1000ton)			57	78	105	111	117	126	135	144	153	162	171	1,359
Cost (U$1000)														
Invest (ex. 5% tax)	64	2951	1577	728	2087	324	85	1098	896	902	526	305	1643	13,186
O&M	0	0	944	1,360	1,502	1,648	1,703	1,814	1,955	2,011	2,151	2,206	2,350	19,644
Total	64	2,951	2,521	2,088	3,589	1,972	1,788	2,912	2,851	2,913	2,677	2,511	3,993	32,830
Benefit (U$1000)														
WTP			1,723	2,358	3,174	3,356	3,537	3,809	4,081	4,353	4,625	4,897	5,169	41,083
Balance	-64	-2,951	-798	270	-415	1,384	1,749	897	1,230	1,440	1,948	2,386	1,176	8,253
													EIRR	17.5%
													B/C	1.251

K.6.7 Total Evaluation

As mentioned so far, it is concluded that the implementation of the priority projects will be feasible from technical, institutional, social, environmental, financial and economical viewpoints.

It should be noted that SWM should be considered as a total system. Achieving balance among SWM components is crucial, e.g., between collection and intermediate treatment, and technical system and institutional system.

In order to make the implementation of the priority projects viable, there are two important issues. The first one is to maintain the financial state of DIMAUD soundly, which can be achieved through income increase by the special collection service for ICI and cost reduction in collection works by employing the knowledge and experiences obtained in the pilot project. The second one is to appropriately supervise the concession contract(s) with the

private sector, which can be attained by strengthened institutional capacity of DIMAUD with experiences and knowledge obtained through the pilot projects and the institutional plan proposed in the M/P

Consequently, it can be said that implementation of the proposed improvement measures in the M/P integrally will ensure the viability of the priority projects.

Annex L

Conclusions and Recommendations

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L Conclusions and Recommendations

L.1 Conclusions

1. Present Situation

Panama District, which has a population of about 744,000 as of 2002, is kept clean. The results of Public Opinion Survey (POS) curried out in the Study clarified that about 70% of the citizens (very satisfied 31%, satisfied 39%) are satisfied with the present Solid Waste Management. This is considered due to efforts of DIMAUD (Municipal Bureau for Urban and Household Cleansing) and organizations/persons concerned, and is highly appreciated.

However, large costs are required for waste collection and street sweeping in order to maintain the city cleanly. It is difficult to say that such works are efficient. If the inefficient works lower collection service quality in the future, the citizens' satisfaction would also lower; the citizens who answered "satisfied," would change "not satisfied."

About 1,200 ton of waste is disposed of at Cerro Patacon Landfill everyday. 80% of it is from Panama District. Medical and industrial wastes are included in the waste brought in. The waste is compacted by heavy equipment, but daily cover soil is not practiced strictly. Furthermore, there are many waste-pickers working inside the landfill, then, it reduces the landfill operation efficiency.

Meanwhile, large quantity of waste from business establishments is assumed as household waste and applied the tariff for household, i.e., waste collection fee per unit of those wastes are same or lower than of household. This is against the Polluter-Pay-Principle (PPP), as well as it reduces DIMAUD's revenue and makes its management unstable.

2. Master Plan

The principal goal of the Master Plan is to establish a sound Solid Waste Management System by the target year 2015 in Panama District, which practically aims to promote the citizens' well-being, to implement sustainable SWM and to contribute to environmental conservation.

Maintenance and improvement of the city's cleanliness and establishment of cost-effective SWM will lead to promotion of the citizens' well-being. Sustainable SWM will be established through Institutional Capacity Building (ICB). And, encouragement of waste reduction, reuse and recycling with environmental education will contribute to environmental conservation.

These issues are not achieved by only DIMAUD's effots. Those can be realized under where the citizens and the SWM executing bodies cooperate each other. The Municipal Ordinance proposed in the Study defines responsibilities and roles of actors, such as dischargers, DIMAUD and the private sector. It is expected that the actors will cooperate each other under the legal framework set by the Municipal Ordinance in order to realize the Sound SWM. For encouraging cooperation from the citizens, it is crucial to carry out educational campaign such as environmental education. Educational methods/skills and materials transferred to the Panamanian side through implementation of the Environmental Education Pilot Project will secure expansion of environmental education and its effectiveness after the Study.

As for the waste collection work, it is important to improve its efficiency without reduction of the service quality. The Collection Improvement Pilot Project transferred skills and knowledge how to do so. It is expected that DIAMUD will expand the pilot project to other areas based on the experience.

As for the final disposal, DIMAUD can improve the landfill operation by adapting cell methods transferred to them through the Landfill Operation Improvement Pilot Project.

At present, hazardous waste is mixed with non-hazardous municipal waste. Facilities to deal with hazardous waste are required to dispose of such mixed waste properly. In this case, costs per ton of waste for construction and O&M of such facilities will surely be much higher than facilities for non-hazardous waste. Then, such costly facilities are not recommendable. In principle, generators should appropriately dispose of their hazardous waste by themselves. However, taking into account the present situation, it is recommendable to properly separate the hazardous waste and to set up a facility for only hazardous waste in the Cerro Patacon Final Disposal Site apart from the proposed landfill for non-hazardous waste.

The issue of waste-pickers is typical in developing and intermediately developed countries. This is usually solved by economic growth that creates job opportunities and by efforts of organizations and persons concerned, but it takes for a long period. Measures that should be taken against this issue in Panama are to control waste-pickers activities hampering the landfill operation and to establish rules of waste picking with taking into account their safety.

As for leachate from the landfill, the existing treatment system cannot meet with the standard set by ANAM, then, the M/P recommends a methods that suites to it.

In views of PPP and DIMAUD's management state, origins and amounts of wastes from business establishments should be clarified and appropriate tariff should be applied for the wastes. In this case, the business establishments need to pay more than before. In order to

induce them to do so, a special collection service that meets with their needs shall be provided.

3. Feasibility Study

Out of the projects and improvement measures proposed in the M/P, the Final Disposal Project and the Transfer and Transport Project are selected as the priority projects for the Feasibility Study and the Pre-feasibility Study from viewpoints of importance and urgency.

It was evaluated that those priority projects would not cause serious technical and social problems. However, it was found that large deficits would happen in the DIMAUD's cash flow, if the priority projects are implemented directly by DIMAUD. Then, the Study recommends to make good use of the private sector in a scheme of concession contract. Open market rates in Panama are considerably high, about 9.5% annually. However, some international banking institutions provide lower interest rates. For example, JBIC, or Japan Bank for International Cooperation, has a financing scheme named as Overseas Investment Loans, which lends money at lower interest rates, e.g., LIBOR plus 0.4 to 0.5%, to Japanese companies or joint ventures of Japanese and local companies. Consequently, it is recommendable to hold an international tender, in which foreign and/or joint companies including from Japan can participate, in order to make DIAMUD's cash flow stable for provision of sound SWM.

4. Cost-Benefit Ratio

1.002 of Cost-Benefit Ratio was obtained by dividing WTP of the citizens for SWM by the total costs for implementation of the all project proposed in the M/P (inc. cost reduction), as shown in the table below.

Total Cost (Cost, U$1,000)	Willingness to Pay (Benefit, U$1,000)	Benefit / Cost
438,206	438,905	1.002

Consequently, it can be said that the society of Panama will be able to bear the costs incurred by implementation of the M/P during 2003 and 2015 as well as achievement of the M/Ps goal.

L.2 Recommendations

1. DIMAUD´s Vision and Mission

The population of the District deserves a Great City; that is the vision of the Mayor´s office and the Municipality. DIMAUD´s vision forms part of standards of life that is being pursued and has the purpose to recover the nickname of "golden cup" for Panama City which used to distinguish this city due to the ornate and cleansing of its roads and public areas.

Within this vision, DIMAUD has a mission that is to implement a sustainable solid waste management to promote the well-being of citizens through the protection of their health and the preservation of the environment.

The Master Plan submitted to the authorities proposes various improvement measures. Of course, DIMAUD will be able to fulfill its mission through implementation of the M/P.

The execution and successful finalization of the M/P depends on the degree of willingness of the Panamanian side, especially DIMAUD.

2. SWM: a public service

A public service should be effective and also efficient. Effectiveness is linked to the attainment of objectives and efficiency is linked to the results.

The main objectives of DIMAUD are linked to two factors, i.e., health and the environment. Both of them are social goods which can be immediately deteriorated if SWM is ineffective. The costs of health service is extremely high for the society; and environmental deterioration is, in cases, irreversible. DIMAUD and competent institutions should join efforts under the principle that it is preferable to invest in public services than to pay the costs for negative externalities derived from deficient SWM.

Effectiveness of the service should be measured based on how diseases linked to deficient solid waste management are being controlled, the preservation of the environment, and better use of the natural resources.

A healthy city has a clean city image. We are going on the right path.

3. Service sustainability: a need

If we are already effective; now, we should be efficient. The M/P could be a guide if the proposed decisions are taken. As a public service which should be provided along the time with quality and efficient costs, it is necessary to structure SWM service with a long term vision. The M/P has a target year set as 2015.

4. Institution

The city is a kind of organizations in which the citizens conduct their activities. Every organization needs “rules of game”, i.e., institutions.

The current legislative period of the Honorable Municipal Council is considering a project of legislation which has, as main purpose, the regulation of the relations between the Municipality, its clients and the private sector. It is necessary that the service has a normative which regulates its operation. It will be the first step to establish responsibilities, duties, and rights of the main actors. Subsequently, the normative could be perfected through the experience attained.

If all actors fulfill their responsibilities, the health and the environment will be protected. At this point, the effective coordination among the competent authorities is of vital importance.

5. Organization

The M/P incorporates a proposal to adjust the organizational structure of DIMAUD. The adjustments are directed to obtain as much synergy as possible among the different administrative units. If we keep in mind that DIMAUD has a social mission to satisfy and objectives to attain, it is necessary that all activities are directed to satisfy that mission and to attain those objectives. As a result, teamwork will be strengthened a matter of course.

The top management has decided to initiate these adjustments which should be permanently evaluated in the face of the operational changes that are also being proposed. Readjustments should be implemented as they are needed.

The experience obtained through the adjustment of the organizational structure will be highly valuable to evaluate the possibility to create a new municipal enterprise for Solid Waste Management for the District. The proposed structure in the M/P corresponds to a kind of enterprise structures. An organization of this type would strengthen the sustainability of the service because it would incorporate long-term planning. Additionally, technical, organizational, and financial capacities can be integrated. A successful example which can be analyzed is the case of the Urban Planning and Research Institute of Curitiba Municipality. This is a municipal enterprise which is world-famous. This way, independence from politics can be attained.

6. Planning

The M/P incorporates planning as a routine task during the development of DIMAUD´s activities. It is necessary to know the direction, the means, and the cost.

Establishment of the Executive Unit would be highly beneficial to plan the attainment of the objectives defined for the entity and the strategies of the top management. The M/P provides a detailed listing of activities to be undertaken by the Executive Unit.

It should be emphasized the need to assign a personnel having enough knowledge and experiences in the SWM sector on a full time basis to integrate various activities assigned to the Executive Unit. The results of the service provision will be linked to the performance of this team.

DIMAUD´s Executive Unit will only be the second unit formed under JICA´s SWM Studies. It is highly recommendable to create a network of executive units on solid waste management which would interact between them. The first unit successfully working is the Planning Office for the Metropolitan Area of San Salvador (OPAMSS).

Monitoring and control of management is a tool for the sustainability of the service. The top management has decided to organize an administrative unit for the control of management as proposed in the M/P. The JICA Study has equipped this unit and the personnel have received training material. The following step would be establish an accounting system which is able to clarify costs of respective activities. With the previous activity, management indicators such as collection cost per ton of waste will be prepared which would be sent to the appointed officers.

Every customer service activity should be personalized. The characteristic of the SWM service requires an active participation of the client in particular and of the public in general. Success in providing the service largely depends on an effective coordination and support between the different actors: DIMAUD and its clients. The M/P introduces a policy of customer service which should be implemented and intensified.

Consequently, the top management has decided to organize an administrative unit for Customer Attention which is formed by S.O.C.I.O., Public Relations and Quality Control sections. The activities to be developed are diverse, but complementary. Teamwork is fundamental i.e., an effective coordination will be of vital importance.

On DIMAUD´s part, the communication system in solid waste management has been organized by creating an administrative unit for customer service. Additionally, the 800ASEO service has been expanded and improved. Now, S.O.C.I.O should be strengthened to complement the communication system.

S.O.C.I.O should promote the constitution of the Committees for Cleansing and Ornate. The Honorable Representatives of the Corregimiento in the District should be informed about the

results which are being obtained in Juan Diaz and Rio Abajo corregimientos in order to include these experiences in their respective corregimientos.

7. Minimization

The Panama District should conduct every effort to encourage waste minimization which is one of the main policies of the M/P.

In this effort, all actors should participate: the customer, the commerce, the industries, the NGO´s, the public entities. All of them should receive DIMAUD´s message: to minimize waste generation.

In order to attain this objective of the policy, DIMAUD should continue the education campaign that initiated in some schools in the Environmental Education Pilot Project. Excellent educational materials are available which should be used rationally and should be reproduced whenever it is necessary. The materials should be delivered to all schools in the District. The goal is to promote public participation in waste minimization activities.

Several schools have joined the recycling program "Cumple tu papel". The program should reinitiate at the beginning of the next school year (2003). DIMAUD should support, strengthen, and expand this program as a manner to promote minimization and education to preserve the environment and conservation of the natural resources.

The private sector should assume its responsibility on generating large amount of waste. This practice is transforming a private cost into a social cost. "Polluters Pay Principle are not well practiced in the Panamanian environmental arrangement. The participation of the private sector is of vital importance to stop the continuous waste generation increment.

The multi-national companies which operate in Panama could transfer their experience, procedures, and practices to minimize solid wastes which are implemented in their respective countries and can become true allies in this crusade. It is necessary to convoke them and motivate their interest.

8. Operations

The operation of the services is the most important activity conducted by DIMAUD. The effectiveness in their performance is a parameter which serves to qualify DIMAUD. However, it is necessary to attain efficiency in the service in order to make SWM sustainable.

The M/P proposes to adjust the organizational structure of DIMAUD in order to improve the efficiency through the integration of all the operations into a single administrative unit: the Operations Department. DIMAUD´s top management has considered convenient this proposal and it has been approved.

It is expected for the Operations Department to achieve a better quality in service and a significant reduction in costs, i.e., to do more with less costs.

9. Collection and Maintenance

During the year 2001, the collection service represented 53% of total expenditures. The Collection Improvement Pilot Project showed that efficiency levels, which are competitive in the Latin-American market, can be attained. The direct costs of labor and associated to vehicle were reduced in about 21% which represents approximately 10% of total collection costs.

Currently, the improvement of two routes has initiated by making use of the Manual of Procedures to Optimize the Routes in the pilot project. If this improvement practice is expanded to the other routes, around of B/.1.4 millions/year could be saved.

Now, DIMAUD has a digitalized map which could be used for planning and optimization of collection routes.

The top management of DIMAUD has decided to organize a Collection Special Service for ICI's (for institutional, commercial, and industrial clients). The wastes collected by DIMAUD from ICI's clients represent about 50% of the total amount of solid wastes.

The participation of ICI's clients in the total income of DIMAUD could increase if the service meets with needs of ICI's.

The M/P includes a strategic procedure to implement this special collection service and DIMAUD could and should initiate procedures to organize it and provide it.

The maintenance activities are linked to the collection activities. The procedures that are used for maintenance should follow necessarily the instructions provided by the manufacturer. The formalities for the procurement of spare parts should be simplified to a minimum.

10. Street Sweeping

With taking into account the present situation, mechanical street sweeping should be incorporated in the roads in the future.

The deployment of waste bins for pedestrians along the roads is part of a program to provide the city with urban furniture which should contribute to keep clean the roads and public areas. This deployment should be continued with taking into consideration DIMAUD's technical input to improve the street sweeping performance.

11. Transfer

DIMAUD should implement the Transfer and Transport Project. The pre-feasibility study should be taken as a base for this purpose. As a priority and due to the urbanization process, the Municipality should consider the acquisition of land which will be necessary for a transfer station.

12. Final Disposal

The M/P has given a significant importance to the final disposal.

The plan to give in concession to the private sector the sanitary landfill operation should be proceeded by taking as a base the M/P feasibility study.

However, some limitations have been detected during the concession process. Among these limitations, there are land ownership issues, San Miguelito Municipality solid waste discharge, and extraction of materials in the operation areas. In order to have a high participation of bidders, it is convenient that those limitations have been overcome at the beginning of the bidding process.

13. Commercialization

The clients database should be completed and updated with the tools provided by General Controller Office (the District database and digitalized map).

The identification of ICI´s clients should be prioritized in order to initiate the Special Collection Service for ICI´s.

The 800ASEO system should be expanded and strengthened. This system will be of great value to support a telephone marketing program which is directed to the new service for ICI´s clients. In the M/P, a scheme is presented which will serve to develop this telephone marketing program to support the activities by the Commercialization Department.

14. Finances

A cash flow projected until 2015 is presented in the M/P. DIMAUD should continue working with these figures and should adjust them to the variations which might occur in the financial sector. Fund requirements should be foreseen well in advance.

The new Management Unit should provide information about the performance of the entity. Management indicators should be used to monitor the performance levels. The efficiency levels projected can be attained if any deviation from them is corrected on time as they occur.

15. Human Resources

The adjustment of the administrative structure which was approved requires an extensive training program. The need to provide training has been detailed in the description of every administrative unit. A continuous training program is essential to achieve an improvement in the performance of the human resources in the whole entity.

The worker should be protected from labor accidents and professional diseases. Coordination with Caja del Seguro Social (Social Security Institution) is essential in occupational health, and medical and emotional attention.

The self-esteem of workers should be developed through a well structured program. A day dedicated to the cleansing workers should be established as an important sign of appreciation from the city to the workers.

16. Organizational Environment

The approval of the Cleansing Regulation (Municipal Ordinance), the definition of objectives for the entity, the adjustment of the organizational structure, and the implementation of the Master Plan requires an extensive and detailed explanation to all members of the working community in DIMAUD.

It is necessary to generate a team work spirit in order to increment the synergy and improve the performance. Similarly, a policy to recognize the work done and to provide incentives and rewards for the workers should improve the organizational environment.

Last Words

We thank the municipality and DIMAUD authorities, as well as the technical and operative personnel who work in those entities because they have helped us to conduct and finalize successfully, in a joint effort, this Study.

We acknowledge the Panamanian C/P for their permanent support and interest in this endeavor.

The learning experiences acquired in this new way to conduct and develop the technical assistance will be of great value for us in future undertakings.