SECTOR I

TABLES

Table 1.1-1 (1/2) Population of the Study Area

Town		Population				
No.	Name	1981	Age:0-17	Age:18-64	Age:65-	1990
1	La Mora	10,624	5,085	5,193	346	11,599
2	El Consejo	10,914	5,127	5363	424	12,196
3	Sabaneta-Los Cerritos	11,289	5,873	5,075	341	13,527
4	La Guruta-La Concepcion	43	21	20	2	2,670
5	El Conde	273	135	115	23	399
6	Tovar	2,675	1,132	1,406	137	3,373
7	Jarillo	1,104	525	539	40	1,034
8	Curiepe	1,783	951	776	56	2,490
9	Las Tejerias	14,461	7,156	6,844	461	20,246
10	Morocopo	354	180	165	9	608
11	La Esperanza	160	56	99	5	455
12	Boqueron (La Penita)	721	347	350	24	968
13	San Daniel	293	159	113	21	299
14	Aniagua	379	205	158	16	521
15	Los Chaguaramos	769	390	353	26	967
16	La Providencia	402	205	182	15	477
17	Tacata	1,002	460	481	61	1,198
18	Palo Negro	370	184	174	12	498
19	Lagunetica	177	75	95	7	258
20	Carrizal	21,012	9,794	10,715	503	30,423
21	San Diego	1,215	477	682	56	1,634
22	Paracotos	4,540	1,892	2,424	224	6,038
23	Parques del Sur	92	39	49	4	200
24	Sabaneta	271	144	120	7	633
25	Los Amarillos	535	289	234	12	779
26	Cortada de Maturin-Maitana	69	34	33	2	361
27	Agua Fria	570	293	266	11	769
28	Cua	23,590	11,557	11,259	774	50,520
29	Las Mercedes de Cua	2,794	1,373	1,323	98	5,969

Source: OCEI

Table 1.1-1 (2/2) Population of the Study Area

Town		Population				
No.	Name	1981	Age:0-17	Age:18-64	Age: 65-	1990
30	La Siempre Viva	847	377	441	29	1,822
31	Quebrada Honda	436	217	206	13	550
32	La Palmita	102	55	44	3	128
33	Colonia Mendoza	1,020	488	484	48	1,538
34	Piloncito (La Cabrera)	2,711	1,376	1,288	47	4,075
35	Ocumare del Tuy	40,666	19,302	19,967	1,397	61,043
36	Los Cajones	504	251	241	12	769
37	Las Yaguas	147	85	55	7	251
38	Sucuta	1,238	665	537	36	1,845
39	San Francisco de Yare	5,152	2,369	2,577	206	9,905
40	Parcelamiento de Yare	535	260	255	20	1,021
41	Pinango	541	310	218	13	338
42	San Jose de Los Altos	1,171	395	728	48	1,571
43	Charallave	29,410	13,822	14,744	844	51,807
44	Santa Barbara	497	284	191	22	1,691
45	(Tuy River Upper Basin)	85,355	40,640	41,890	2,825	113,393
46	(Tuy River Middle Basin)	112,103	53,774	54,692	3,637	196,070
47	(Tuy River Basin)	197,458	94,414	96,582	6,462	309,463
48	(Caracas)	2,577,127	908,222	1,576,028	92,877	3,124,171

Source: OCEI

Table 1.2-1 (1/2) Number of Household Samples by Income Group

Town No.	Town Name	No Income	<Bs 200000 /month	Bs 200000-1000000/month	>Bs1000000 /month	Total Inhabitants
1	La Mora	n.a.	n.a.	n.a.	n.a.	n.a.
2	El Consejo	3,793	2,735	256	276	7,060
3	Sabaneta-Los Cerritos	3,740	2,526	127	337	6,730
4	La Gruta-La Concepcion	13	12	1	2	28
5	El Conde	103	58	1	13	175
6	Tovar	806	876	67	81	1,830
7	Jarillo	318	386	7	26	737
8	Curiepe	646	398	17	53	1,114
9	Las Tejerias	5,058	3,636	286	348	9,328
10	Morocopo	101	110	7	2	220
11	La Esperanza	55	45	2	2	104
12	Boqueron (La Penita)	2	186	14	20	222
13	San Daniel	96	67	0	6	169
14	Aniagua	135	5	0	7	147
15	Los Chaguaramos	279	39	1	29	348
16	La Providencia	176	69	1	5	251
17	Tacata	357	262	21	15	655
18	Palo Negro	94	123	8	2	227
19	Lagunetica	54	61	1	4	120
20	Carrizal	6,883	5,832	776	354	13,845
21	San Diego	446	388	52	13	899
22	Paracotos	1,355	1,608	149	57	3,169
23	Parques del Sur	29	34	2	1	66
24	Sabaneta	75	69	2	1	147
25	Los Amarillos	207	125	4	8	344
26	Cortada de Maturin-Maitana	23	20	1	0	44
27	Agua Fria	209	129	6	10	354
28	Cua	7,632	6,082	645	481	14,840
29	Las Mercedes de Cua	907	632	57	66	1,662

Source: Based on 1981 data prepared by OCEI.

Table 1.2-1 (2/2) Number of Household Samples by Income Group

Town No.	Town Name	No Income	<Bs 200000 /month	Bs 200000-1000000/month	>Bs1000000 /month	Total Inhabitants
30	La Siempre Viva	279	187	6	44	516
31	Quebrada Honda	183	53	7	3	246
32	La Palmita	42	2	0	3	47
33	Colonia Mendoza	364	275	21	14	674
34	Piloncito (La Cabrera)	851	698	46	97	1,692
35	Ocumare del Tuy	13,671	10,868	1,283	864	26,686
36	Los Cajones	155	133	4	25	317
37	Las Yaguas	52	24	1	0	77
38	Sucuta	407	258	20	25	710
39	San Francisco de Yare	1,651	1,290	301	144	3,386
40	Parcelamiento de Yare	194	148	9	7	358
41	Pinango	164	115	5	9	293
42	San Jose de Los Altos	490	241	157	25	913
43	Charallave	9,426	8,196	1,049	640	19,311
44	Santa Barbara	159	96	2	27	284
45	(Tuy River Upper Basin)	24,849	19,824	1,960	1,654	48,287
46	(Tuy River Middle Basin)	36,831	29,273	3,462	2,492	72,058
47	(Tuy River Basin)	61,680	49,097	5,422	4,146	120,345
48	(Caracas)	19,456	725,403	335,392	5,604	1,085,855

Source: Based on 1981 data prepared by OCEI.

Table 1.2-2 (1/2) Employment Structure (1981)

Town		Sector			Total
No.	Name	Agriculture	Industry	Services	Employees
1	La Mora	n.a.	n.a.	n.a.	n.a.
2	El Consejo	81	1,649	1226	2956
3	Sabaneta-Los Cerritos	178	1,411	984	2,573
4	La Guruta-La Concepcion	2	10	2	14
5	El Conde	32	8	20	60
6	Tovar	383	126	471	980
7	Jarillo	329	28	54	411
8	Curiepe	50	235	155	440
9	Las Tejerias	236	2,048	1,610	3,894
10	Morocopo	101	8	16	125
11	La Esperanza	16	6	30	52
12	Boqueron (La Penita)	23	43	136	202
13	San Daniel	56	0	9	65
14	Aniagua	7	1	2	10
15	Los Chaguaramos	31	20	21	72
16	La Providencia	25	30	19	74
17	Tacata	35	86	153	274
18	Palo Negro	27	32	71	130
19	Lagunetica	7	21	26	54
20	Carrizal	181	2,847	3,587	6,615
21	San Diego	52	148	231	431
22	Paracotos	88	762	880	1,730
23	Parques del Sur	5	23	7	35
24	Sabaneta	2	44	27	73
25	Los Amarillos	8	49	55	112
26	Cortada de Maturin-Maitana	6	10	6	22
27	Agua Fria	18	35	78	131
28	Cua	129	3,244	3,214	6,587
29	Las Mercedes de Cua	53	358	259	670

Source: OCEI

Table 1.2-2 (2/2) Employment Structure (1981)

Town		Sector			Total
No.	Name	Agriculture	Industry	Services	Employees
30	La Siempre Viva	24	113	62	199
31	Quebrada Honda	21	25	15	61
32	La Palmita	4	2	2	8
33	Colonia Mendoza	71	125	100	296
34	Piloncito (La Cabrera)	18	423	291	732
35	Ocumare del Tuy	409	5,327	6,230	11,966
36	Los Cajones	134	11	9	154
37	Las Yaguas	12	9	10	31
38	Sucuta	61	143	75	279
39	San Francisco de Yare	41	812	745	1,598
40	Parcelamiento de Yare	19	83	54	156
41	Pinango	8	86	30	124
42	San Jose de Los Altos	34	94	266	394
43	Charallave	158	4,053	4,708	8,919
44	Santa Barbara	43	20	35	98
45	(Tuy River Upper Basin)	1,943	9,656	10,066	21,665
46	(Tuy River Middle Basin)	1,275	14,952	15,915	32,142
47	(Tuy River Basin)	3,218	24,608	25,981	53,807
48	(Caracas)	10,297	268,224	670,358	948,879

Source: OCEI

Table 1.3-1(1/2) No. of Households Served with Utility (1990)

Town		Utility			Total
No.	Name	Water	Sewer	Gas	Households
1	La Mora	n.a.	n.a.	n.a.	n.a.
2	El Consejo	2,309	1,107	1,769	2683
3	Sabaneta-Los Cerritos	1,445	73	1,320	2,113
4	La Guruta-La Concepcion	328	328	642	642
5	El Conde	65	0	50	108
6	Tovar	350	32	1,032	1,032
7	Jarillo	90	5	259	323
8	Curiepe	0	0	0	0
9	Las Tejerias	4,441	2,465	3,926	5,374
10	Morocopo	0	0	81	102
11	La Esperanza	4	0	71	109
12	Boqueron (La Penita)	0	0	0	0
13	San Daniel	74	12	8	103
14	Aniagua	0	16	6	136
15	Los Chaguaramos	0	0	0	0
16	La Providencia	5	10	10	174
17	Tacata	268	95	178	327
18	Palo Negro	129	6	104	145
19	Lagunetica	340	49	1,360	1,563
20	Carrizal	3,411	1,871	3,550	6,063
21	San Diego	1,610	234	1,670	1,670
22	Paracotos	1,102	313	1,062	1,299
23	Parques del Sur	80	11	80	95
24	Sabaneta	87	27	124	165
25	Los Amarillos	0	0	0	0
26	Cortada de Maturin-Maitana	13	13	130	165
27	Agua Fria	0	0	0	0
28	Cua	13,515	9,515	12,040	15,582
29	Las Mercedes de Cua	0	0	0	0

Source: Based on 1981 and 1990 data prepared by OCEI.

Table 1.3-1(2/2) No. of Households Served with Utility (1990)

Town		Utility			Total
No.	Name	Water	Sewer	Gas	Households
30	La Siempre Viva	0	0	0	0
31	Quebrada Honda	233	0	420	1233
32	La Palmita	92	92	185	428
33	Colonia Mendoza	0	0	0	0
34	Piloncito (La Cabrera)	0	0	0	0
35	Ocumare del Tuy	14,595	9,299	13,280	17,478
36	Los Cajones	0	0	0	0
37	Las Yaguas	4	0	13	115
38	Sucuta	0	0	0	0
39	San Francisco de Yare	2,310	1,835	1,977	5,348
40	Parcelamiento de Yare	0	0	0	0
41	Pinango	0	0	0	0
42	San Jose de Los Altos	0	0	0	0
43	Charallave	9,654	5,472	10,769	13,287
44	Santa Barbara	134	0	131	162
45	(Tuy River Upper Basin)	15,979	6,603	17,212	23,821
46	(Tuy River Middle Basin)	40,709	26,277	39,035	54,203
47	(Tuy River Basin)	56,688	32,880	56,247	78,024
48	(Caracas)	503,524	290,822	n.a.	600,103

Source: Based on 1981 and 1990 data prepared by OCEI.

Table 1.3-2 (1/2) Number of Students (1990)

Town		Education			Total
No.	Name	Pre-School	Primary and Secondary	Tertiary and higher	Students
1	La Mora	0	0	0	0
2	El Consejo	261	0	0	261
3	Sabaneta-Los Cerritos	60	819	0	879
4	La Guruta-La Concepcion	0	0	0	0
5	El Conde	0	1,989	0	1,989
6	Tovar	84	0	55	139
7	Jarillo	0	0	0	0
8	Curiepe	1	0	0	1
9	Las Tejerias	0	0	0	0
10	Morocopo	0	111	0	111
11	La Esperanza	0	124	0	124
12	Boqueron (La Penita)	0	0	0	0
13	San Daniel	0	8	0	8
14	Aniagua	0	0	0	0
15	Los Chaguaramos	0	0	0	0
16	La Providencia	0	0	0	0
17	Tacata	60	644	37	741
18	Palo Negro	0	0	0	0
19	Lagunetica	0	736	0	736
20	Carrizal	951	5,582	361	6,894
21	San Diego	166	992	54	1,212
22	Paracotos	179	585	37	801
23	Parques del Sur	0	265	0	265
24	Sabaneta	0	0	0	0
25	Los Amarillos	0	0	0	0
26	Cortada de Maturin-Maitana	0	0	0	0
27	Agua Fria	33	130	0	163
28	Cua	2,106	6,816	651	9,573
29	Las Mercedes de Cua	0	0	0	0

Source: OCEI

Table 1.3-2 (2/2) Number of Students (1990)

Town		Education			Total
No.	Name	Pre-School	Primary and Secondary	Tertiary and higher	Students
30	La Siempre Viva	0	0	0	0
31	Quebrada Honda	0	0	0	0
32	La Palmita	22	0	0	22
33	Colonia Mendoza	3	6	0	9
34	Piloncito (La Cabrera)	0	0	0	0
35	Ocumare del Tuy	2,417	16,297	982	19,696
36	Los Cajones	0	108	0	108
37	Las Yaguas	0	0	9	9
38	Sucuta	0	571	0	571
39	San Francisco de Yare	407	4,272	130	4,809
40	Parcelamiento de Yare	0	0	0	0
41	Pinango	0	0	0	0
42	San Jose de Los Altos	0	0	0	0
43	Charallave	1,852	12,345	619	14,816
44	Santa Barbara	0	0	0	0
45	(Tuy River Upper Basin)	1,795	11,720	544	14,059
46	(Tuy River Middle Basin)	6,807	40,680	2,391	49,878
47	(Tuy River Basin)	8,602	52,400	2,935	63,937
48	(Caracas)	97,190	298,332	45,881	441,403

Source: OCEI

Table 1.3-3 (1/2) Number of Medical Institutions (1990)

Town No.	Town Name	Hospital	Health Center Urban	Health Center Rural	Total Institutions
1	La Mora	0	0	0	0
2	El Consejo	0	0	0	0
3	Sabaneta-Los Cerritos	0	0	0	0
4	La Guruta-La Concepcion	0	0	0	0
5	El Conde	0	0	0	0
6	Tovar	0	0	0	0
7	Jarillo	0	0	1	1
8	Curiepe	0	0	0	0
9	Las Tejerias	0	0	0	0
10	Morocopo	0	0	0	0
11	La Esperanza	0	0	0	0
12	Boqueron (La Penita)	0	0	0	0
13	San Daniel	0	0	0	0
14	Aniagua	0	0	1	1
15	Los Chaguaramos	0	0	1	1
16	La Providencia	0	0	0	0
17	Tacata	0	0	1	1
18	Palo Negro	0	0	1	1
19	Lagunetica	0	0	1	1
20	Carrizal	2	1	0	3
21	San Diego	0	0	1	1
22	Paracotos	0	0	2	2
23	Parques del Sur	0	0	0	0
24	Sabaneta	0	0	0	0
25	Los Amarillos	0	0	0	0
26	Cortada de Maturin-Maitana	0	0	0	0
27	Agua Fria	0	0	1	1
28	Cua	1	0	2	3
29	Las Mercedes de Cua	0	0	1	1

Source: OCEI

Table 1.3-3 (2/2) Number of Medical Institutions (1990)

Town No.	Town Name	Hospital	Health Center Urban	Health Center Rural	Total Institutions
30	La Siempre Viva	0	0	0	0
31	Quebrada Honda	0	0	1	1
32	La Palmita	0	0	0	0
33	Colonia Mendoza	0	0	1	1
34	Piloncito (La Cabrera)	0	0	0	0
35	Ocumare del Tuy	3	0	11	14
36	Los Cajones	0	0	0	0
37	Las Yaguas	0	0	0	0
38	Sucuta	0	0	0	0
39	San Francisco de Yare	0	0	1	1
40	Parcelamiento de Yare	0	0	0	0
41	Pinango	0	0	0	0
42	San Jose de Los Altos	0	0	0	0
43	Charallave	1	0	1	2
44	Santa Barbara	0	0	0	0
45	(Tuy River Upper Basin)	2	1	8	11
46	(Tuy River Middle Basin)	5	0	20	25
47	(Tuy River Basin)	7	1	28	36
48	(Caracas)	108	0	0	108

Source: OCEI

Table 2.2.1 Outlays and Incomes for
Ocumarito-Tuy III Pumping Plan

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Operation & Maintenance	0	0	0	1450	1450	1450	1450	1450	1450	1450
Payment of Interest	0	0	0	212	552	659	615	567	517	464
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	209	570	744	789	836	886	940
Outlays	0	0	0	1871	2572	2854	2854	2854	2854	2854
Household Income (mln US$)	4953	5144	5341	5547	5760	5982	6212	6451	6699	6956
Ratio of Allocations (%)	0.000	0.000	0.000	0.034	0.045	0.048	0.046	0.044	0.043	0.041
Incomes	0	0	0	1871	2572	2854	2854	2854	2854	2854

No.	11	12	13	14	15	16	17	18	19	20
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Operation & Maintenance	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450
Payment of Interest	408	348	284	217	146	71	16	0	0	0
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	996	1056	1119	1186	1257	912	265	0	0	0
Outlays	2854	2854	2854	2854	2854	2433	1731	1450	1450	1450
Household Income (mln US$)	7224	7502	7790	8090	8401	8724	9060	9408	9770	10146
Ratio of Allocations (%)	0.040	0.038	0.037	0.035	0.034	0.028	0.019	0.015	0.015	0.014
Incomes	2854	2854	2854	2854	2854	2433	1731	1450	1450	1450

Source: JICA

Table 2.2.2 Outlays and Incomes for Guare Dam Plan

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Operation & Maintenance	0	0	0	0	0	0	1170	1170	1170	1170
Payment of Interest	0	0	0	272	527	2123	3621	4471	4706	4340
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	268	553	2195	3937	5246	6105	6471
Outlays	0	0	0	540	1080	4319	8728	10887	11981	11981
Household Income (mln US$)	4953	5144	5341	5547	5760	5982	6212	6451	6699	6956
Ratio of Allocations (%)	0.000	0.000	0.000	0.010	0.019	0.072	0.141	0.169	0.179	0.172
Incomes	0	0	0	540	1080	4319	8728	10887	11981	11981

No.	11	12	13	14	15	16	17	18	19	20
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Operation & Maintenance	1170	1170	1170	1170	1170	1170	1170	1170	1170	1170
Payment of Interest	3952	3540	3104	2641	2151	1632	1113	596	243	62
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	6859	7271	7707	8169	8660	8639	8618	5896	3011	1032
Outlays	11981	11981	11981	11981	11981	11441	10901	7662	4423	2264
Household Income (mln US$)	7224	7502	7790	8090	8401	8724	9060	9408	9770	10146
Ratio of Allocations (%)	0.166	0.160	0.154	0.148	0.143	0.131	0.120	0.081	0.045	0.022
Incomes	11981	11981	11981	11981	11981	11441	10901	7662	4423	2264

Source: JICA

Table 2.2.3 Outlays and Incomes for Sand Settling Pond for Intake

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Operation & Maintenance	0	0	0	0	61	61	61	61	61	61
Payment of Interest	0	0	0	47	90	131	169	157	144	131
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	46	95	147	202	214	226	240
Outlays	0	0	0	93	246	339	432	432	432	432
Household Income (mln US$)	5341	5547	5760	5982	6212	6451	6699	6956	7224	7502
Ratio of Allocations (%)	0.000	0.000	0.000	0.002	0.004	0.005	0.006	0.006	0.006	0.006
Incomes	0	0	0	93	246	339	432	432	432	432

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Operation & Maintenance	61	61	61	61	61	61	61	62	61	61
Payment of Interest	116	101	85	68	50	30	15	5	0	0
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	254	270	286	303	321	248	170	87	0	0
Outlays	432	432	432	432	432	339	246	154	61	61
Household Income (mln US$)	7790	8090	8401	8724	9060	9408	9770	10146	10536	10941
Ratio of Allocations (%)	0.006	0.005	0.005	0.005	0.005	0.004	0.003	0.002	0.001	0.001
Incomes	432	432	432	432	432	339	246	154	61	61

Source: JICA

Table 2.2.4 Outlays and Incomes for Environmental Fund (Short-Term Program)

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Operation & Maintenance	0	0	0	0	120	120	120	120	120	120
Payment of Interest	0	0	0	438	836	1207	1550	1439	1321	1197
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	433	877	1349	1848	1959	2077	2201
Outlays	0	0	0	871	1833	2676	3518	3518	3518	3518
Sales (million US$)	560001	560001	560001	560001	560001	560001	560001	560001	560001	560001
Ratio of Allocations (%)	0.000	0.000	0.000	0.155	0.327	0.476	0.628	0.628	0.628	0.628
Incomes	0	0	0	871	1833	2676	3518	3518	3518	3518

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Operation & Maintenance	120	120	120	120	120	120	120	120	120	120
Payment of Interest	1065	925	776	619	452	275	140	48	0	0
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	2333	2473	2622	2779	2946	2252	1544	795	0	0
Outlays	3518	3518	3518	3518	3518	2647	1805	962	120	120
Sales (million US$)	560001	560001	560001	560001	560001	560001	560001	560001	0	0
Ratio of Allocations (%)	0.628	0.628	0.628	0.628	0.628	0.473	0.322	0.172	0.000	0.000
Incomes	3518	3518	3518	3518	3518	2647	1805	962	120	120

Source: JICA

Table 2.2.5 Outlays and Incomes for Environmental Fund (Medium-Term Program)

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Operation & Maintenance	0	0	0	0	0	0	0	120	120	120
Payment of Interest	0	0	0	179	348	505	651	784	903	1008
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	177	365	564	775	998	1236	1487
Outlays	0	0	0	356	713	1069	1426	1902	2258	2615
Sales (million US$)	443969	443969	443969	443969	443969	443969	443969	443969	443969	443969
Ratio of Allocations (%)	0.000	0.000	0.000	0.080	0.161	0.241	0.321	0.428	0.509	0.589
Incomes	0	0	0	356	713	1069	1426	1902	2258	2615

No.	11	12	13	14	15	16	17	18	19	20
Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Operation & Maintenance	120	120	120	120	120	120	120	120	120	120
Payment of Interest	919	824	724	618	505	386	281	191	117	59
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	1576	1671	1771	1877	1990	1753	1501	1235	953	653
Outlays	2615	2615	2615	2615	2615	2258	1902	1546	1189	833
Sales (million US$)	443969	443969	443969	443969	443969	443969	443969	443969	443969	443969
Ratio of Allocations (%)	0.589	0.589	0.589	0.589	0.589	0.509	0.428	0.348	0.268	0.188
Incomes	2615	2615	2615	2615	2615	2258	1902	1546	1189	833

Source: JICA

Table 2.2.6 Outlays and Incomes for Sewage Treatment Plant in Ocumare del Tuy (S-T)

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Operation & Maintenance	0	0	0	0	519	519	519	519	519	519
Payment of Interest	0	0	0	175	340	494	636	590	542	491
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	173	356	551	757	802	850	901
Outlays	0	0	0	348	1215	1563	1911	1911	1911	1911
Household Income	112154	119641	127628	136148	145236	154932	165274	176308	188078	200634
Ratio of Allocations (%)	0.000	0.000	0.000	0.256	0.837	1.009	1.156	1.084	1.016	0.953
Incomes	0	0	0	348	1215	1563	1911	1911	1911	1911

No.	11	12	13	14	15	16	17	18	19	20
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Operation & Maintenance	519	519	519	519	519	519	519	519	519	519
Payment of Interest	437	380	319	254	186	114	58	20	0	0
Replacement	0	0	0	0	0	1112	1112	1112	1112	0
Payment of Principal	955	1013	1074	1138	1206	930	638	328	0	0
Outlays	1911	1911	1911	1911	1911	2675	2327	1979	1631	519
Household Income	214028	228317	243559	243559	243559	243559	243559	243559	243559	243559
Ratio of Allocations (%)	0.893	0.837	0.785	0.785	0.785	1.098	0.955	0.812	0.669	0.213
Incomes	1911	1911	1911	1911	1911	2675	2327	1979	1631	519

Source: JICA

Table 2.2.7 Outlays and Incomes for Sewage Treatment Plant in Ocumare del Tuy (M-T)

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Operation & Maintenance	0	0	0	172	172	172	172	172	172	172
Payment of Interest	0	0	0	41	80	115	108	100	91	82
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	40	83	129	137	145	153	163
Outlays	0	0	0	253	335	416	416	416	416	416
Household Income	165274	176308	188078	200634	214028	228317	243559	243559	243559	243559
Ratio of Allocations (%)	0.000	0.000	0.000	0.126	0.156	0.182	0.171	0.171	0.171	0.171
Incomes	0	0	0	253	335	416	416	416	416	416

No.	11	12	13	14	15	16	17	18	19	20
Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Operation & Maintenance	172	172	172	172	172	172	172	172	172	172
Payment of Interest	72	62	51	39	27	14	5	0	0	0
Replacement	0	0	0	0	0	855	855	855	0	0
Payment of Principal	172	183	194	205	218	149	77	0	0	0
Outlays	416	416	416	416	416	1190	1108	1027	172	172
Household Income	243559	243559	243559	243559	243559	243559	243559	243559	243559	243559
Ratio of Allocations (%)	0.171	0.171	0.171	0.171	0.171	0.489	0.455	0.422	0.071	0.071
Incomes	416	416	416	416	416	1190	1108	1027	172	172

Source: JICA

Table 2.2.8 Outlays and Incomes for Sewage Treatment Plant in Las Tejerias

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Operation & Maintenance	0	0	0	0	319	319	319	319	319	319
Payment of Interest	0	0	0	45	87	127	163	151	139	126
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	44	91	141	194	206	218	231
Outlays	0	0	0	89	498	587	676	676	676	676
Household Income	32331	33670	35066	36518	38032	39607	41182	42820	44523	46293
Ratio of Allocations (%)	0.000	0.000	0.000	0.245	1.308	1.482	1.642	1.579	1.519	1.461
Incomes	0	0	0	89	498	587	676	676	676	676

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Operation & Maintenance	319	319	319	319	319	319	319	319	319	319
Payment of Interest	112	97	82	65	48	29	15	5	0	0
Replacement	0	0	0	0	0	683	683	683	683	0
Payment of Principal	245	260	275	292	309	239	164	84	0	0
Outlays	676	676	676	676	676	1269	1180	1091	1002	319
Household Income	48134	48134	48134	48134	48134	48134	48134	48134	48134	48134
Ratio of Allocations (%)	1.405	1.405	1.405	1.405	1.405	2.637	2.452	2.266	2.081	0.663
Incomes	676	676	676	676	676	1269	1180	1091	1002	319

Source: JICA

Table 2.2.9 Outlays and Incomes for Sewage Treatment Plant in San Francisco de Yare

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Operation & Maintenance	0	0	0	0	343	343	343	343	343	343
Payment of Interest	0	0	0	63	122	178	229	212	195	177
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	62	128	198	272	289	306	324
Outlays	0	0	0	125	593	719	844	844	844	844
Household Income	29657	32121	34790	37681	40812	44203	47876	47876	47876	47876
Ratio of Allocations (%)	0.000	0.000	0.000	0.332	1.454	1.626	1.762	1.762	1.762	1.762
Incomes	0	0	0	125	593	719	844	844	844	844

No.	11	12	13	14	15	16	17	18	19	20
Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Operation & Maintenance	343	343	343	343	343	343	343	343	343	343
Payment of Interest	157	137	115	92	67	41	21	7	0	0
Replacement	0	0	0	0	0	773	773	773	773	0
Payment of Principal	344	364	386	409	434	335	230	118	0	0
Outlays	844	844	844	844	844	1491	1366	1241	1116	343
Household Income	47876	47876	47876	47876	47876	47876	47876	47876	47876	47876
Ratio of Allocations (%)	1.762	1.762	1.762	1.762	1.762	3.114	2.853	2.591	2.330	0.716
Incomes	844	844	844	844	844	1491	1366	1241	1116	343

Source: JICA

Table 2.2.10 Outlays and Incomes for Sewage Treatment Plant in El Consejo

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Operation & Maintenance	0	0	0	0	300	300	300	300	300	300
Payment of Interest	0	0	0	16	32	46	59	55	51	46
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	16	33	52	71	75	80	84
Outlays	0	0	0	33	365	398	430	430	430	430
Household Income	27414	27867	28327	28795	28795	28795	28795	28795	28795	28795
Ratio of Allocations (%)	0.000	0.000	0.000	0.113	1.268	1.381	1.494	1.494	1.494	1.494
Incomes	0	0	0	33	365	398	430	430	430	430

No.	11	12	13	14	15	16	17	18	19	20
Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Operation & Maintenance	300	300	300	300	300	300	300	300	300	300
Payment of Interest	41	36	30	24	17	11	5	2	0	0
Replacement	0	0	0	0	0	750	750	750	750	0
Payment of Principal	89	95	100	106	113	87	60	31	0	0
Outlays	430	430	430	430	430	1148	1115	1083	1050	300
Household Income	28795	28795	28795	28795	28795	28795	28795	28795	28795	28795
Ratio of Allocations (%)	1.494	1.494	1.494	1.494	1.494	3.986	3.873	3.760	3.646	1.042
Incomes	430	430	430	430	430	1148	1115	1083	1050	300

Source: JICA

Table 2.2.11 Outlays and Budget Allocations for Sand Settling Pond (Medium-Term)

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Operation & Maintenance	0	0	0	627	627	627	627	627	627	627
Payment of Interest	0	0	0	271	527	765	714	659	602	541
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	268	552	853	905	959	1016	1077
Outlays	0	0	0	1166	1706	2245	2245	2245	2245	2245
Budget (million US$)	641	666	693	721	749	779	811	843	877	912
Ratio of Allocations (%)	0.000	0.000	0.000	0.162	0.228	0.288	0.277	0.266	0.256	0.246
Budget Allocations	0	0	0	1166	1706	2245	2245	2245	2245	2245

No.	11	12	13	14	15	16	17	18	19	20
Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Operation & Maintenance	627	627	627	627	627	627	627	627	627	627
Payment of Interest	476	408	335	258	176	90	31	0	0	0
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	1142	1211	1283	1360	1442	989	509	0	0	0
Outlays	2245	2245	2245	2245	2245	1706	1166	627	627	627
Budget (million US$)	948	986	1026	1067	1109	1154	1200	1248	1298	1350
Ratio of Allocations (%)	0.237	0.228	0.219	0.210	0.202	0.148	0.097	0.050	0.048	0.046
Budget Allocations	2245	2245	2245	2245	2245	1706	1166	627	627	627

Source: JICA

Table 2.2.12 Outlays and Budget Allocations for Reforestation (Short-Term)

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Operation & Maintenance	0	0	0	0	0	0	17	17	17	17
Payment of Interest	0	0	0	30	58	85	109	131	151	139
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	30	61	94	130	167	207	219
Outlays	0	0	0	60	119	179	256	315	375	375
Budget (million US$)	506	527	548	569	592	616	641	666	693	721
Ratio of Allocations (%)	0.000	0.000	0.000	0.010	0.020	0.029	0.040	0.047	0.054	0.052
Budget Allocations	0	0	0	60	119	179	256	315	375	375

No.	11	12	13	14	15	16	17	18	19	20
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Operation & Maintenance	17	17	17	17	17	17	17	17	17	17
Payment of Interest	126	112	97	81	65	47	32	20	10	3
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	232	246	261	277	293	251	207	159	109	56
Outlays	375	375	375	375	375	315	256	196	136	77
Budget (million US$)	749	779	811	843	877	912	948	986	1026	1067
Ratio of Allocations (%)	0.050	0.048	0.046	0.044	0.043	0.035	0.027	0.020	0.013	0.007
Budget Allocations	375	375	375	375	375	315	256	196	136	77

Source: JICA

Table 2.2.13 Outlays and Budget Allocations for Reforestation (Medium-Term)

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Operation & Maintenance	0	0	0	0	0	0	0	33	33	33
Payment of Interest	0	0	0	52	102	148	190	229	264	294
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	52	107	165	226	292	361	434
Outlays	0	0	0	104	208	312	416	554	658	762
Budget (million US$)	641	666	693	721	749	779	811	843	877	912
Ratio of Allocations (%)	0.000	0.000	0.000	0.014	0.028	0.040	0.051	0.066	0.075	0.084
Budget Allocations	0	0	0	104	208	312	416	554	658	762

No.	11	12	13	14	15	16	17	18	19	20
Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Operation & Maintenance	33	33	33	33	33	33	33	33	33	33
Payment of Interest	268	241	212	180	148	113	82	56	34	17
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	460	488	517	548	581	512	439	361	278	191
Outlays	762	762	762	762	762	658	554	449	345	241
Budget (million US$)	948	986	1026	1067	1109	1154	1200	1248	1298	1350
Ratio of Allocations (%)	0.080	0.077	0.074	0.071	0.069	0.057	0.046	0.036	0.027	0.018
Budget Allocations	762	762	762	762	762	658	554	449	345	241

Source: JICA

Table 2.2.14 Outlays and Budget Allocations for Institutional Measures (Exc. E. F.)

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Operation & Maintenance	0	0	217	217	217	217	217	217	217	217
Payment of Interest	0	0	0	61	118	111	103	94	86	76
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	60	124	131	139	147	156	166
Outlays	0	0	217	338	459	459	459	459	459	459
Budget (million US$)	218	227	236	246	255	266	276	287	299	311
Ratio of Allocations (%)	0.000	0.000	0.092	0.138	0.180	0.173	0.166	0.160	0.153	0.148
Budget Allocations	0	0	217	338	459	459	459	459	459	459

No.	11	12	13	14	15	16	17	18	19	20
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Operation & Maintenance	217	217	217	217	217	217	217	217	217	217
Payment of Interest	66	56	45	33	20	7	0	0	0	0
Replacement	0	0	0	0	0	851	851	0	0	0
Payment of Principal	176	186	197	209	222	114	0	0	0	0
Outlays	459	459	459	459	459	1189	1068	217	217	217
Budget (million US$)	323	336	350	364	378	393	409	425	442	460
Ratio of Allocations (%)	0.142	0.136	0.131	0.126	0.121	0.302	0.261	0.051	0.049	0.047
Budget Allocations	459	459	459	459	459	1189	1068	217	217	217

Source: JICA

Table 3.1.1 Estimation of Economic Benefits

1. Appreciation of Estate Values

1) Estimated Number of Houses near the Tuy River and its Tributaries in 1997

River/Tributaries	Number of Houses
(1) Tuy River	16,572
(2) Qda. Tiquirito	177
(3) Qda. Morocopo	710
(4) Qda. Chorreron	1,751
(5) Qda. de Guayas	595
(6) Qda. Maitana	541
(7) Qdas. Araguita, Yarito and Parroyo	2,448
(8) Qda. Charallave	8,828
Total	31,622

Note (1)The number of houses near the Tuy River is the sum total of those located within 200 m from the river, starting from near El Consejo and reaching down to Toma de Agua.

(2)Qdas Araguita, Yarito and Parroyo flow through the town of Ocumare del Tuy.

(3)The number of houses near a quebrada is 50% of the sum total of those located within 200 m from the quebrada.

2) Estimation of Benefits

Multiple Regression Equation: $y = 78.63+7.38x_1-6.30x_2-10.88x_3$

where

y : price of a house (including plot) per m2 of floor area (Bs. thousand)

x_1: distance from the Tuy River
(x_1=1: <50m, 2: 50m=<<100m, 3: 100m=<<200m, 4: 200m=<)

x_2: distance to the commercial center(s) (time on foot)
(x_2=1: <10 min., 2: 10 min.=<<20 min., 3:=<20 min.)

x_3: security of location
(x_3=1: very safe, 2: safe, 3: sometimes not safe, 4: not safe)

Number of samples: 61 houses

Partial correlation coefficients and t values
x_1: 0.33617 (2.76486), x_2: -0.16851 (-1.32422), x_3: -0.25311 (-2.02655)

Multiple correlation coefficient and t value
0.40984 (3.42181)

$y(x_1=4) - y(x_1=2)$ = 14.76 (Bs. thousand/m2)
Bs.14.76 thousand/m2 x 95.7m2 (average floor area) x 31,622 (No. of houses) /(Bs.470/US$) = US$95,036 thousand
US$95,036 thousand x 0.65 (contribution rate of F/S projects) = US$61,773 thousand
US$61,773 thousand x 0.90 (conversion factor) = US$55,596 thousand

2. Enhancement of the Value of the Tuy River Basin as a Tourism Resource

1) Time Value

US$2,729 (per capita GDP)/365 (days) x (85,120 (No. of people to the project area per year in the with project case) - 33,143 (No. of people to the project area per year in the without project case)) = US$389 thousand
US$389 x 0.65 (contribution rate of F/S projects) = US$253 thousand
US$253 thousand x 0.96 (conversion factor) = US$243 thousand

2) Operation Cost of Vehicles

Depreciation

US$30,000 (purchase price of a car)/10 (years(durable life of a car))/365 (days) x (85,120 - 33,143)/4.2 (No. of members per household) = US$102 thousand
US$102 x 0.65 (contribution rate of F/S projects) = US$66 thousand
US$66 thousand x 0.89 (conversion factor) = US$59 thousand

Fuel Cost

Bs.55 (fuel cost per litre) x 20 (liter) x (85,120 - 33,143)/4.2/(Bs.470/US$) = US$29 thousand
US$29 x 0.65 (contribution rate of F/S projects) = US$19 thousand
US$19 thousand x 1.28 (conversion factor) = US$24 thousand

US$59 thousand + US$24 thousand = US$83 thousand

3) Commercial Earnings in the Project Area

Bs.10,000 (spending per household) x (85,120 - 33,143)/4.2 x 0.3 (commercial profit rate)/(Bs.470/US$) = US$79 thousand
US$79 x 0.65 (contribution rate of F/S projects) = US$51 thousand
US$51 thousand x 0.84 (conversion factor) = US$43 thousand

3. Appreciation of the Existence Value of the Tuy River Basin

Bs.235,911 (monthly household income) x 12 (months) x 0.00302 (ratio of environmental tax a household is willing to pay to preserve the existence value of the Tuy River basin per year to annual household income) x 423,973 (population in the project area)/4.2 /(Bs.470/US$) = US$1,836 thousand
US$1,836 x 0.65 (contribution rate of F/S projects) = US$1,193 thousand
US$1,193 thousand x 0.96 (conversion factor) = US$1,145 thousand

4. Reduction of Water-Borne Diseases

1) Reduction of Medical Cost

Regression Equation: y = 0.9818 - 0.2344x

where y : number of water-borne disease cases per household per year
(water-borne diseases: diarrhea, dysentery and skin diseases)

x : distance from the Tuy River
(x=1: <50m, 2: 50m=<<100m, 3: 100m=<<200m, 4: 200m=<)

Number of samples: 113 households

Correlation coefficient and t value
-0.23967 (-2.61261)

y(x=4) - y(x=2) = 0.4688 (case/household)
0.4688 case/household x 31,622 households = 14,824 cases
14,824 x Bs.9,909 (medical cost per case) = Bs.147 million
Bs.147 million/(Bs.470/US$) = US$313 thousand
US$313 x 0.65 (contribution rate of F/S projects) = US$203 thousand
US$203 thousand x 0.96 (conversion factor) = US$195 thousand

2) Reduction of No. of Days in Bed

14,824 (cases) x US$2,729 (per capita GDP)/365 (days) x 1.71 (No. of days in bed per case)) = US$190 thousand
US$190 x 0.65 (contribution rate of F/S projects) = US$124 thousand
US$124 thousand x 0.96 (conversion factor) = US$119 thousand

3) Total

US$195 thousand + US$119 thousand = US$314 thousand

5. Reduction of Turbidity

1) Sand Settling Pond for Intake

US$485 thousand (reduction of water intake suspension due to turbidity) x 0.87 (conversion factor) + US$238 thousand (reduction of chemicals for pre-treatment) x 0.96 (conversion factor) + US$96 thousand (elimination of necessity for pre-treatment pond cleaning by heavy machine) x 0.83 (conversion factor) + US$ 127 thousand (reduction of water intake suspension for sediment disposal) x 0.87 (conversion factor) = US$840 thousand

2) Reforestation in Priority Areas

US$53 thousand (reduction of water intake suspension) x 0.87 (conversion factor) + US$7 thousand (reduction of chemicals for pre-treatment) x 0.96 (conversion factor) = US$53 thousand

6. Reduction of Water Intake Suspension at Toma de Agua due to Color and Odor

2.80 m3/sec. x 60 sec./min. x 60 min./hr. x 8 hr./time x 36 times x (0.17 (ratio of suspension due to color) + 0.19 (ratio of suspension due to odor)) x US$0.327/m3 (opportunity cost of water per m3) = US$342 thousand
US$342 thousand x 0.96 (conversion factor) = US$328 thousand

7. Reduction of Chemicals for Pre-Treatment

US$388 thousand (annual cost of chlorine) x 0.65 (estimated reduction rate of the cost of chlorine by F/S project) = US$252 thousand
US$252 thousand x 0.96 (conversion factor) = US$242 thousand

Table 3.1.2 Conversion Factors for Major Items

1. Cost

(1) Treatment Plant for Factories and Piggeries

Cost Items	Conversion Factors
A. Initial Cost	
1. Tanks	0.91
2. Pumps	0.87
3. Instruments	0.91
B. O & M Cost	
1. Personnel	0.81
2. Electricity	0.61
3. Chemicals	0.96

(2) Sand Settling Pond

Cost Items	Conversion Factors
A. Initial Cost	
1. Site Preparation	0.83
2. Excavation and Backfilling	0.83
3. Structure Construction	0.91
4. Bridges	0.89
5. Pipeline Installation	0.92
6. Gates and Screen	
(1) Sluice Gate	0.91
(2) Motorized Winch	0.87
(3) Carbon Steel Screen	0.91
B. O & M Cost	
1. Personnel	0.81
2. Electricity	0.61

(3) Sewage Treatment Plants

Cost Items	Conversion Factors
A. Initial Cost	
1. Land Acquisition	0.90
2. Site Preparation Works/Earthworks	0.83
3. Roadworks	0.86
4. Structures	0.91
5. Yard Piping	0.92
6. Pumps	0.87
7. Filters	0.91

Cost Items	Conversion Factors
8. Process Equipment	0.93
9. Gas Storage	0.90
10. Operation and Maintenance Equipment	0.91
11. Pumping Station	0.91
12. Sewers	0.92
B. O & M Cost	
1. Personnel	0.81
2. Electricity	0.61
3. General Operation Expenses	
(1) Sludge Disposal	0.83
(2) Equipment Maintenance	0.81
(3) Testing	0.97
(4) Miscellaneous (S.C.F.)	0.96

(4) Reforestation

Cost Items	Conversion Factors
A. Initial Cost	
1. Nursery	
(1) Site Preparation	0.83
(2) Roadworks	0.89
(3) Buildings	0.91
(4) Irrigation System	0.93
(5) Nursery Beds	0.83
2. Operation	
(1) New Road	0.86
(2) Others	0.81

2. Benefits

Cost Items	Conversion Factors
1. Real Estate	0.90
2. Medical Cost	0.96
3. Fuel	1.28
4. Cars	0.89
5. Commerce	0.84
6. Chemicals	0.96
7. Water	0.87
8. S.C.F.	0.96

Source: Based on "Sistema Nacional de Inversion Publica", CORDIPLAN

Table 3.1.3 Allocation of Benefits to Projects

1. Allocation Formulas

Types of Benefits	Installation of Treatment Plants in Factories	Construction of Sand Settling Pond for Intake	Construction of Sewage Treatment Plant in Ocumare del Tuy	Construction of Sewage Treatment Plant in Las Tejerias	Reforestation in Priority Areas
1)Appreciation of estate values	(P1 p1+P2 q1+ P3) r	-	(P1 p2+P2 q2) r s1	(P1 p2+P2 q2) r s2	P2 q3 R
2)Enhancement of tourism value of Tuy River basin	(P1 p1+P2 q1+ P3) r	-	(P1 p2+P2 q2) r s1	(P1 p2+P2 q2) r s2	P2 q3 R
3)Appreciation of "existence value" of Tuy River basin	(P1 p1+P2 q1+ P3) r	-	(P1 p2+P2 q2) r s1	(P1 p2+P2 q2) r s2	P2 q3 R
4)Reduction of water-borne diseases	p1 r	-	p2 r s1	p2 r s2	-
5)Reduction of turbidity	-	m1+n1+u+v	-	-	m2+n2
6)Reduction of water intake suspension due to color & odor	1	-	-	-	-
7)Reduction of chemicals for pre-treatment	p1 r	-	p2 r s1	p2 r s2	-

2. Explanation of Codes

Code	Meaning	Estimated Value	Remarks
P1	Contribution of BOD effluents to pollution	0.80	ΣP= 1
P2	Contribution of turbidity to pollution	0.15	
P3	Contribution of toxicants to pollution	0.05	
p1	Contribution of installation of treatment plants in factories and piggeries to reduction of pollution by BOD effluents	0.53	Σp= 1
p2	Contribution of construction of sewage treatment plants to reduction of pollution by BOD effluents	0.47	
q1	Contribution of installation of treatment plants in factories and piggeries to reduction of pollution by turbidity	0.13	Σq= 1

Code	Meaning	Estimated Value	Remarks
q2	Contribution of construction of sewage treatment plants to reduction of pollution by turbidity	0.03	
q3	Contribution of reforestation to reduction of pollution by turbidity	0.84	
r	Contribution of F/S projects to reduction of pollution as targeted by M/P	0.65	
R	Contribution of reforestation in priority areas to reduction of turbidity as targeted by M/P	0.08	
s1	Contribution of construction of sewage treatment plant in Ocumare del Tuy to reduction of pollution by construction of sewage treatment plants in Ocumare del Tuy and Las Tejerias	0.75	$\Sigma s = 1$
s2	Contribution of construction of sewage treatment plant in Las Tejerias to reduction of pollution by construction of sewage treatment plants in Ocumare del Tuy and Las Tejerias	0.25	
m1	Benefit deriving from reduction of water intake suspension due to turbidity to be attributed to construction of sand settling pond for intake	-	
m2	Benefit deriving from reduction of water intake suspension due to turbidity to be attributed to reforestation in priority areas	-	
n1	Benefit deriving from reduction of chemical cost as a result of reduction of turbidity to be attributed to construction of sand settling pond for intake	-	
n2	Benefit deriving from reduction of chemical cost as a result of reduction of turbidity to be attributed to reforestation in priority areas	-	
u	Benefit deriving from elimination of cost for pre-treatment pond cleaning by heavy machine to be attributed to construction of sand settling pond for intake	-	
v	Benefit deriving from reduction of water intake suspension for sediment disposal to be attributed to construction of sand settling pond for intake	-	

In the immediately above table "Pi" is a theoretically determined value, "pi" is based on the existing contribution of a polluter to BOD effluents, "qi" is based on the existing contribution of a polluter to turbidity, "r" and "R" are theoretically determined values, and "si" is based on the existing population share of a town.

Table 3.2.1 Cost Benefit Streams - Installation of Treatment Plants in Factories

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:US$ thousand)

NO.	YEAR	CC	OM	CS	BF	CF
1	1998	0	0	0	0	0
2	1999	0	0	0	0	0
3	2000	3088	0	3088	0	-3088
4	2001	6175	0	6175	0	-6175
5	2002	6175	0	6175	0	-6175
6	2003	6175	0	6175	0	-6175
7	2004	0	1522	1522	39557	38035
8	2005	0	1522	1522	3657	2135
9	2006	0	1522	1522	3808	2286
10	2007	0	1522	1522	3965	2443
11	2008	0	1522	1522	4130	2608
12	2009	0	1522	1522	4303	2781
13	2010	0	1522	1522	4484	2962
14	2011	0	1522	1522	4673	3151
15	2012	0	1522	1522	4871	3349
16	2013	0	1522	1522	5079	3557
17	2014	0	1522	1522	5296	3774
18	2015	1849	1522	3371	5523	2152
19	2016	3698	1522	5220	5762	542
20	2017	3698	1522	5220	6011	791
21	2018	3698	1522	5220	6272	1052
22	2019	0	1522	1522	6545	5023
23	2020	0	1522	1522	6832	5310
24	2021	0	1522	1522	7131	5609
25	2022	0	1522	1522	7445	5923
26	2023	0	1522	1522	7773	6251
27	2024	0	1522	1522	8117	6595
28	2025	0	1522	1522	8477	6955
29	2026	0	1522	1522	8854	7332
30	2027	0	1522	1522	9249	7727
31	2028	0	1522	1522	9662	8140
32	2029	0	1522	1522	10095	8573
33	2030	0	1522	1522	10548	9026
34	2031	0	1522	1522	11022	9500
35	2032	0	1522	1522	11519	9997
36	2033	0	1522	1522	12039	10517

Table 3.3.1 Cost Benefit Streams - Construction of Sand Settling Pond for Intake

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:US$ thousand)

NO.	YEAR	CC	OM	CS	BF	CF
1	1998	0	0	0	0	0
2	1999	0	0	0	0	0
3	2000	565	0	565	0	-565
4	2001	3670	0	3670	0	-3670
5	2002	1412	0	1412	0	-1412
6	2003	0	13	13	840	827
7	2004	0	13	13	840	827
8	2005	0	13	13	840	827
9	2006	0	13	13	840	827
10	2007	0	13	13	840	827
11	2008	0	13	13	840	827
12	2009	0	13	13	840	827
13	2010	0	13	13	840	827
14	2011	0	13	13	840	827
15	2012	0	13	13	840	827
16	2013	0	13	13	840	827
17	2014	0	13	13	840	827
18	2015	11	13	24	840	816
19	2016	71	13	84	840	756
20	2017	27	13	40	840	800
21	2018	0	13	13	840	827
22	2019	0	13	13	840	827
23	2020	0	13	13	840	827
24	2021	0	13	13	840	827
25	2022	0	13	13	840	827
26	2023	0	13	13	840	827
27	2024	0	13	13	840	827
28	2025	0	13	13	840	827
29	2026	0	13	13	840	827
30	2027	0	13	13	840	827
31	2028	0	13	13	840	827
32	2029	0	13	13	840	827
33	2030	0	13	13	840	827
34	2031	0	13	13	840	827
35	2032	0	13	13	840	827
36	2033	0	13	13	840	827

Table 3.3.2 Outlays and Incomes for Sand Settling Pond for Intake

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Operation & Maintenance	0	0	0	17	17	17	17	17	17	17
Payment of Interest	0	0	0	45	332	424	396	366	335	302
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	44	333	464	491	521	552	585
Outlays	0	0	0	106	682	904	904	904	904	904
Household Income (mln US$)	5341	5547	5760	5982	6212	6451	6699	6956	7224	7502
Ratio of Allocations (%)	0.000	0.000	0.000	0.002	0.011	0.014	0.013	0.013	0.013	0.012
Incomes	0	0	0	106	682	904	904	904	904	904

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Operation & Maintenance	17	17	17	17	17	17	17	17	17	17
Payment of Interest	267	230	190	148	104	57	13	0	0	0
Replacement	0	0	0	0	0	13	81	31	0	0
Payment of Principal	620	658	697	739	783	742	209	0	0	0
Outlays	904	904	904	904	904	828	320	48	17	17
Household Income (mln US$)	7790	8090	8401	8724	9060	9408	9770	10146	10536	10941
Ratio of Allocations (%)	0.012	0.011	0.011	0.010	0.010	0.009	0.003	0.000	0.000	0.000
Incomes	904	904	904	904	904	828	320	48	17	17

Source: JICA

Table 3.3.3 Outlays and Budget Allocations for Sand Settling Pond for Intake

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Operation & Maintenance	0	0	0	17	17	17	17	17	17	17
Payment of Interest	0	0	0	45	332	424	396	366	335	302
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	44	333	464	491	521	552	585
Outlays	0	0	0	106	682	904	904	904	904	904
Budget	79273	80858	82476	84125	85808	87524	89274	91060	92881	94739
Ratio of Allocations (%)	0.000	0.000	0.000	0.126	0.795	1.033	1.013	0.993	0.974	0.955
Budget Allocations	0	0	0	106	682	904	904	904	904	904

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Operation & Maintenance	17	17	17	17	17	17	17	17	17	17
Payment of Interest	267	230	190	148	104	57	13	0	0	0
Replacement	0	0	0	0	14	13	81	31	0	0
Payment of Principal	620	658	697	739	783	742	209	0	0	0
Outlays	904	904	904	904	918	828	320	48	17	17
Budget	96633	98566	100537	102548	104599	106691	108825	111001	113221	115486
Ratio of Allocations (%)	0.936	0.917	0.899	0.882	0.878	0.776	0.294	0.043	0.015	0.015
Budget Allocations	904	904	904	904	918	828	320	48	17	17

Source: JICA

Table 3.3.4(1) Financial Statements for Sand Settling Pond for Intake

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Income Statement										
Revenue	0	0	0	889	925	962	1001	1041	1083	1127
Operation and Maintenance	0	0	0	17	17	17	17	17	17	17
Depreciation	0	0	0	161	161	161	161	161	161	161
Payment of Interest	0	0	0	45	332	424	396	366	335	302
Expenditure	0	0	0	223	510	602	574	545	513	480
Profit before Tax	0	0	0	666	414	360	426	496	570	647
Tax	0	0	0	226	141	122	145	169	194	220
Profit after Tax	0	0	0	439	273	237	281	328	376	427
Funds Statement										
Profit after Tax	0	0	0	439	273	237	281	328	376	427
Loans	625	4060	1562	0	0	0	0	0	0	0
Government Budget	0	0	0	0	0	0	0	0	0	0
Depreciation	0	0	0	161	161	161	161	161	161	161
Sources	625	4060	1562	601	435	399	443	489	537	588
Capital Works	625	4060	1562	0	0	0	0	0	0	0
Payment of Principal	0	0	0	44	333	464	491	521	552	585
Working Capital	0	0	0	557	101	-65	-49	-32	-15	3
Applications	625	4060	1562	601	435	399	443	489	537	588
Balance Sheet										
Liabilities	662	5005	6961	7290	7062	6598	6107	5586	5033	4448
Capital	0	0	0	439	713	950	1232	1559	1935	2362
Liabilities and Capital	662	5005	6961	7729	7774	7548	7338	7145	6969	6810
Current Assets	0	0	0	557	658	593	544	513	498	501
Fixed Assets	662	5005	6961	7172	7116	6955	6794	6632	6471	6310
Assets	662	5005	6961	7729	7774	7548	7338	7145	6969	6810

Source: JICA

Table 3.3.4(2) Financial Statements for Sand Settling Pond for Intake

(Unit: thousand US$)

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Income Statement										
Revenue	1173	1220	1269	1320	1374	1429	1487	1547	1610	748
Operation and Maintenance	17	17	17	17	17	17	17	17	17	17
Depreciation	161	161	161	161	161	161	161	161	161	161
Payment of Interest	267	230	190	148	104	57	13	0	0	0
Expenditure	445	408	369	327	282	235	191	178	178	178
Profit before Tax	727	812	901	994	1091	1194	1296	1369	1431	569
Tax	247	276	306	338	371	406	441	465	487	194
Profit after Tax	480	536	594	656	720	788	855	903	945	376
Funds Statement										
Profit after Tax	480	536	594	656	720	788	855	903	945	376
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	0	0	0	0	0	0	0	0	0	0
Depreciation	161	161	161	161	161	161	161	161	161	161
Sources	641	697	756	817	882	949	1017	1065	1106	537
Capital Works	0	0	0	0	0	0	0	0	0	0
Payment of Principal	620	658	697	739	783	742	209	0	0	0
Working Capital	21	40	59	78	98	195	726	1033	1106	537
Applications	641	697	756	817	882	949	1017	1065	1106	537
Balance Sheet										
Liabilities	3828	3170	2473	1734	951	209	-0	-0	-0	-0
Capital	2842	3378	3972	4628	5348	6136	6992	7895	8840	9216
Liabilities and Capital	6670	6548	6445	6362	6299	6346	6992	7895	8840	9216
Current Assets	522	561	620	698	796	992	1718	2751	3857	4395
Fixed Assets	6148	5987	5826	5664	5503	5354	5274	5144	4982	4821
Assets	6670	6548	6445	6362	6299	6346	6992	7895	8840	9216

Source: JICA

Table 3.4.1 Cost Benefit Streams - Construction of Sewage Treatment Plant in Ocumare del Tuy

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:US$ thousand)

NO.	YEAR	CC	OM	CS	BF	CF
1	1998	2816	0	2816	0	-2816
2	1999	5988	0	5988	0	-5988
3	2000	7461	0	7461	0	-7461
4	2001	3532	0	3532	0	-3532
5	2002	2305	0	2305	0	-2305
6	2003	2305	0	2305	0	-2305
7	2004	0	243	243	22744	22501
8	2005	0	243	243	1966	1723
9	2006	0	243	243	2056	1813
10	2007	0	243	243	2149	1906
11	2008	0	243	243	2247	2004
12	2009	0	243	243	2350	2107
13	2010	0	243	243	2457	2214
14	2011	0	243	243	2570	2327
15	2012	0	243	243	2687	2444
16	2013	867	243	1110	2811	1701
17	2014	1445	243	1688	2940	1252
18	2015	2023	243	2266	3076	809
19	2016	482	243	725	3218	2493
20	2017	0	243	243	3366	3123
21	2018	0	243	243	3522	3279
22	2019	0	243	243	3685	3442
23	2020	0	243	243	3856	3613
24	2021	0	243	243	4035	3792
25	2022	0	243	243	4222	3979
26	2023	0	243	243	4419	4176
27	2024	0	243	243	4624	4381
28	2025	0	243	243	4840	4597
29	2026	0	243	243	5065	4822
30	2027	0	243	243	5302	5059
31	2028	0	243	243	5549	5306
32	2029	0	243	243	5809	5566
33	2030	0	243	243	6080	5837
34	2031	0	243	243	6365	6122
35	2032	0	243	243	6663	6420
36	2033	0	243	243	6975	6732

Table 3.4.2 Outlays and Incomes for Sewage Treatment Plant in Ocumare del Tuy

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Operation & Maintenance	0	0	0	0	0	0	341	341	341	341
Payment of Interest	0	0	0	78	238	428	484	512	535	489
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	77	244	461	571	667	769	816
Outlays	0	0	0	154	481	890	1396	1521	1645	1645
Household Income	112154	119641	127628	136148	145236	154932	165274	176308	188078	200634
Ratio of Allocations (%)	0.000	0.000	0.000	0.102	0.298	0.517	0.760	0.776	0.787	0.738
Sales of Factories	57026	60247	63655	67261	71076	75113	79384	83903	89328	95111
Ratio of Allocations (%)	0.000	0.000	0.000	0.023	0.068	0.118	0.176	0.181	0.184	0.173
Incomes	0	0	0	154	481	890	1396	1521	1645	1645

No.	11	12	13	14	15	16	17	18	19	20
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Operation & Maintenance	341	341	341	341	341	341	341	341	341	341
Payment of Interest	440	388	333	275	213	147	87	43	21	7
Replacement	0	0	0	0	0	958	1597	2235	0	0
Payment of Principal	864	916	971	1030	1091	1003	736	372	228	117
Outlays	1645	1645	1645	1645	1645	2449	2761	2991	590	466
Household Income	214028	228317	243559	243559	243559	243559	243559	243559	243559	243559
Ratio of Allocations (%)	0.692	0.649	0.608	0.608	0.608	0.905	1.020	1.105	0.218	0.172
Sales of Factories	101274	107843	114846	114846	114846	114846	114846	114846	114846	114846
Ratio of Allocations (%)	0.162	0.153	0.143	0.143	0.143	0.213	0.240	0.260	0.051	0.041
Incomes	1645	1645	1645	1645	1645	2449	2761	2991	590	466

Source: JICA

Table 3.4.3(1) Financial Statements for Sewage Treatment Plant in Ocumare del Tuy

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Income Statement										
Revenue	0	0	0	0	0	0	1622	1729	1845	1967
Operation and Maintenance	0	0	0	0	0	0	341	341	341	341
Depreciation	0	0	0	0	0	0	818	818	818	818
Payment of Interest	0	0	0	78	238	428	484	512	535	489
Expenditure	0	0	0	78	238	428	1643	1671	1694	1648
Profit before Tax	0	0	0	-78	-238	-428	-20	58	151	320
Tax	0	0	0	0	0	0	0	20	51	109
Profit after Tax	0	0	0	-78	-238	-428	-20	38	100	211
Funds Statement										
Profit after Tax	0	0	0	-78	-238	-428	-20	38	100	211
Loans	1086	2303	2873	1166	877	877	0	0	0	0
Government Budget	2017	4276	5335	2165	1628	1628	0	0	0	0
Depreciation	0	0	0	0	0	0	818	818	818	818
Sources	3103	6579	8208	3253	2267	2077	798	856	917	1029
Capital Works	3103	6579	8208	3331	2505	2505	0	0	0	0
Payment of Principal	0	0	0	77	244	461	571	667	769	816
Working Capital	-0	0	0	-154	-481	-890	226	189	148	213
Applications	3103	6579	8208	3253	2267	2077	798	856	917	1029
Balance Sheet										
Liabilities	1151	3661	6926	8423	9376	9979	9522	8914	8144	7329
Capital	2017	6293	11629	13716	15107	16307	16286	16325	16424	16635
Liabilities and Capital	3169	9954	18555	22139	24483	26285	25809	25239	24569	23964
Current Assets	0	0	0	-154	-636	-1525	-1299	-1110	-962	-749
Fixed Assets	3169	9954	18555	22293	25119	27810	27107	26349	25531	24713
Assets	3169	9954	18555	22139	24483	26285	25809	25239	24569	23964

Source: JICA

Table 3.4.3(2) Financial Statements for Sewage Treatment Plant in Ocumare del Tuy

(Unit: thousand US$)

No.	11	12	13	14	15	16	17	18	19	20
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Income Statement										
Revenue	2098	2238	2387	2387	2387	2387	2387	2387	2387	2387
Operation and Maintenance	341	341	341	341	341	341	341	341	341	341
Depreciation	818	818	818	818	818	818	818	818	818	818
Payment of Interest	440	388	333	275	213	147	87	43	21	7
Expenditure	1599	1547	1492	1433	1372	1306	1246	1202	1180	1166
Profit before Tax	500	691	896	954	1016	1081	1141	1185	1208	1221
Tax	170	235	304	324	345	368	388	403	411	415
Profit after Tax	330	456	591	630	670	714	753	782	797	806
Funds Statement										
Profit after Tax	330	456	591	630	670	714	753	782	797	806
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	0	0	0	0	0	0	0	0	0	0
Depreciation	818	818	818	818	818	818	818	818	818	818
Sources	1148	1274	1409	1447	1488	1531	1571	1600	1615	1624
Capital Works	0	0	0	0	0	0	0	0	0	0
Payment of Principal	864	916	971	1030	1091	1003	736	372	228	117
Working Capital	283	358	438	418	397	-429	-761	-1007	1387	1506
Applications	1148	1274	1409	1447	1488	1531	1571	1600	1615	1624
Balance Sheet										
Liabilities	6464	5548	4577	3547	2456	1453	717	346	117	-0
Capital	16965	17422	18013	18642	19313	20026	20779	21562	22359	23165
Liabilities and Capital	23430	22970	22589	22189	21768	21479	21497	21907	22476	23165
Current Assets	-465	-107	330	748	1145	715	-46	-1053	334	1840
Fixed Assets	23895	23077	22259	21442	20624	20764	21543	22960	22142	21325
Assets	23430	22970	22589	22189	21768	21479	21497	21907	22476	23165

Source: JICA

Table 3.5.1 Cost Benefit Streams - Construction of Sewage Treatment Plant in Las Tejerias

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:US$ thousand)

NO.	YEAR	CC	OM	CS	BF	CF
1	1998	0	0	0	0	0
2	1999	0	0	0	0	0
3	2000	2553	0	2553	0	-2553
4	2001	2429	0	2429	0	-2429
5	2002	4329	0	4329	0	-4329
6	2003	1021	0	1021	0	-1021
7	2004	0	146	146	7544	7398
8	2005	0	146	146	652	506
9	2006	0	146	146	682	536
10	2007	0	146	146	713	567
11	2008	0	146	146	745	599
12	2009	0	146	146	779	633
13	2010	0	146	146	815	669
14	2011	0	146	146	852	706
15	2012	0	146	146	891	745
16	2013	0	146	146	932	786
17	2014	0	146	146	975	829
18	2015	962	146	1108	1020	-87
19	2016	583	146	729	1067	338
20	2017	1369	146	1515	1117	-399
21	2018	0	146	146	1168	1022
22	2019	0	146	146	1222	1076
23	2020	0	146	146	1279	1133
24	2021	0	146	146	1338	1192
25	2022	0	146	146	1400	1254
26	2023	0	146	146	1466	1320
27	2024	0	146	146	1534	1388
28	2025	0	146	146	1605	1459
29	2026	0	146	146	1680	1534
30	2027	0	146	146	1758	1612
31	2028	0	146	146	1841	1695
32	2029	0	146	146	1927	1781
33	2030	0	146	146	2017	1871
34	2031	0	146	146	2111	1965
35	2032	0	146	146	2210	2064
36	2033	0	146	146	2313	2167

Table 3.5.2 Outlays and Incomes for Sewage Treatment Plant in Las Tejerias

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Operation & Maintenance	0	0	0	0	194	194	194	194	194	194
Payment of Interest	0	0	0	40	76	139	146	136	124	112
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	40	80	152	177	187	199	211
Outlays	0	0	0	80	350	486	517	517	517	517
Household Income	32331	33670	35066	36518	38032	39607	41182	42820	44523	46293
Ratio of Allocations (%)	0.000	0.000	0.000	0.110	0.460	0.613	0.628	0.604	0.581	0.558
Sales of Factories	120378	126601	133148	140033	147277	154896	164191	174045	184492	195567
Ratio of Allocations (%)	0.000	0.000	0.000	0.029	0.119	0.157	0.157	0.149	0.140	0.132
Incomes	0	0	0	80	350	486	517	517	517	517

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Operation & Maintenance	194	194	194	194	194	194	194	194	194	194
Payment of Interest	100	86	72	57	41	24	11	2	0	0
Replacement	0	0	0	0	0	1060	643	1510	0	0
Payment of Principal	223	237	251	266	282	219	156	30	0	0
Outlays	517	517	517	517	517	1497	1004	1735	194	194
Household Income	48134	48134	48134	48134	48134	48134	48134	48134	48134	48134
Ratio of Allocations (%)	0.537	0.537	0.537	0.537	0.537	1.555	1.043	1.803	0.202	0.202
Sales of Factories	207310	207310	207310	207310	207310	207310	207310	207310	207310	207310
Ratio of Allocations (%)	0.125	0.125	0.125	0.125	0.125	0.361	0.242	0.419	0.047	0.047
Incomes	517	517	517	517	517	1497	1004	1735	194	194

Source: JICA

Table 3.5.3(1) Financial Statements for Sewage Treatment Plant in Las Tejerias

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Income Statement										
Revenue	0	0	0	0	666	697	732	768	807	847
Operation and Maintenance	0	0	0	0	194	194	194	194	194	194
Depreciation	0	0	0	0	392	392	392	392	392	392
Payment of Interest	0	0	0	40	76	139	146	136	124	112
Expenditure	0	0	0	40	662	725	732	721	710	698
Profit before Tax	0	0	0	-40	5	-28	0	47	97	149
Tax	0	0	0	0	2	0	0	16	33	51
Profit after Tax	0	0	0	-40	3	-28	0	31	64	98
Funds Statement										
Profit after Tax	0	0	0	-40	3	-28	0	31	64	98
Loans	564	534	954	222	0	0	0	0	0	0
Government Budget	2257	2134	3817	888	0	0	0	0	0	0
Depreciation	0	0	0	0	392	392	392	392	392	392
Sources	2821	2668	4771	1069	395	364	392	423	455	490
Capital Works	2821	2668	4771	1110	0	0	0	0	0	0
Payment of Principal	0	0	0	40	80	152	177	187	199	211
Working Capital	0	0	0	-80	315	212	215	235	257	279
Applications	2821	2668	4771	1069	395	364	392	423	455	490
Balance Sheet										
Liabilities	598	1200	2283	2575	2574	2437	2260	2072	1874	1663
Capital	2257	4391	8208	9056	9059	9031	9031	9062	9126	9224
Liabilities and Capital	2855	5591	10491	11631	11632	11468	11291	11135	11000	10887
Current Assets	0	0	0	-80	235	446	661	896	1153	1432
Fixed Assets	2855	5591	10491	11711	11398	11021	10630	10238	9847	9455
Assets	2855	5591	10491	11631	11632	11468	11291	11135	11000	10887

Source: JICA

Table 3.5.3(2) Financial Statements for Sewage Treatment Plant in Las Tejerias

(Unit: thousand US$)

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Income Statement										
Revenue	889	889	889	889	889	889	889	889	889	889
Operation and Maintenance	194	194	194	194	194	194	194	194	194	194
Depreciation	392	392	392	392	392	392	392	392	392	392
Payment of Interest	100	86	72	57	41	24	11	2	0	0
Expenditure	685	672	658	643	627	610	597	587	586	586
Profit before Tax	204	217	232	247	263	280	293	302	304	304
Tax	69	74	79	84	89	95	99	103	103	103
Profit after Tax	135	143	153	163	173	184	193	199	200	200
Funds Statement										
Profit after Tax	135	143	153	163	173	184	193	199	200	200
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	0	0	0	0	0	0	0	0	0	0
Depreciation	392	392	392	392	392	392	392	392	392	392
Sources	526	535	544	554	565	576	585	591	592	592
Capital Works	0	0	0	0	0	0	0	0	0	0
Payment of Principal	223	237	251	266	282	219	156	30	0	0
Working Capital	303	298	293	288	283	-703	-214	-949	592	592
Applications	526	535	544	554	565	576	585	591	592	592
Balance Sheet										
Liabilities	1440	1203	952	686	404	186	30	-0	-0	-0
Capital	9359	9503	9655	9818	9992	10176	10369	10569	10769	10970
Liabilities and Capital	10799	10706	10608	10504	10396	10362	10399	10569	10769	10970
Current Assets	1735	2033	2327	2615	2898	2195	1982	1033	1625	2217
Fixed Assets	9064	8672	8281	7889	7498	8166	8417	9536	9144	8753
Assets	10799	10706	10608	10504	10396	10362	10399	10569	10769	10970

Source: JICA

Table 3.6.1 Cost Benefit Streams - Reforestation in Priority Areas

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:US$ thousand)

NO.	YEAR	CC	OM	CS	BF	CF
1	1998	170	0	170	0	-170
2	1999	511	0	511	0	-511
3	2000	511	0	511	0	-511
4	2001	511	0	511	0	-511
5	2002	511	0	511	0	-511
6	2003	511	0	511	0	-511
7	2004	0	0	0	847	847
8	2005	0	0	0	113	113
9	2006	0	0	0	116	116
10	2007	0	0	0	119	119
11	2008	0	0	0	122	122
12	2009	0	0	0	126	126
13	2010	0	0	0	129	129
14	2011	0	0	0	132	132
15	2012	0	0	0	136	136
16	2013	0	0	0	140	140
17	2014	0	0	0	144	144
18	2015	0	0	0	149	149
19	2016	0	0	0	153	153
20	2017	0	0	0	158	158
21	2018	0	0	0	163	163
22	2019	0	0	0	168	168
23	2020	0	0	0	173	173
24	2021	0	0	0	179	179
25	2022	0	0	0	185	185
26	2023	0	0	0	191	191
27	2024	0	0	0	198	198
28	2025	0	0	0	204	204
29	2026	0	0	0	211	211
30	2027	0	0	0	219	219
31	2028	0	0	0	227	227
32	2029	0	0	0	235	235
33	2030	0	0	0	243	243
34	2031	0	0	0	252	252
35	2032	0	0	0	262	262
36	2033	0	0	0	272	272

Table 3.6.2 Outlays and Budget Allocations for Reforestation in Priority Areas

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Operation & Maintenance	0	0	0	0	0	0	0	0	0	0
Payment of Interest	0	0	0	14	58	99	138	174	206	190
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	13	59	107	158	212	269	285
Outlays	0	0	0	27	117	206	296	386	475	475
Budget (million US$)	506	527	548	569	592	616	641	666	693	721
Ratio of Allocations (%)	0.000	0.000	0.000	0.005	0.020	0.034	0.046	0.058	0.069	0.066
Budget Allocations	0	0	0	27	117	206	296	386	475	475

No.	11	12	13	14	15	16	17	18	19	20
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Operation & Maintenance	0	0	0	0	0	0	0	0	0	0
Payment of Interest	173	155	136	115	94	71	48	29	15	5
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	302	321	340	360	382	378	311	240	164	85
Outlays	475	475	475	475	475	448	359	269	179	90
Budget (million US$)	749	779	811	843	877	912	948	986	1026	1067
Ratio of Allocations (%)	0.063	0.061	0.059	0.056	0.054	0.049	0.038	0.027	0.017	0.008
Budget Allocations	475	475	475	475	475	448	359	269	179	90

Source: JICA

Table 3.7.1 Outlays and Incomes for Environmental Fund

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Operation & Maintenance	0	0	0	0	177	177	177	177	177	177
Payment of Interest	0	0	0	257	728	1170	1579	1470	1353	1229
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	254	750	1275	1832	1942	2059	2182
Outlays	0	0	0	512	1655	2622	3589	3589	3589	3589
Sales (million US$)	560001	560001	560001	560001	560001	560001	560001	560001	560001	560001
Ratio of Allocations (%)	0.000	0.000	0.000	0.091	0.295	0.468	0.641	0.641	0.641	0.641
Incomes	0	0	0	512	1655	2622	3589	3589	3589	3589

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Operation & Maintenance	177	177	177	177	177	177	177	177	177	177
Payment of Interest	1099	960	813	657	491	316	161	55	0	0
Replacement	0	0	0	0	0	200	0	0	0	0
Payment of Principal	2313	2452	2599	2755	2921	2584	1772	912	0	0
Outlays	3589	3589	3589	3589	3589	3277	2110	1144	177	177
Sales (million US$)	560001	560001	560001	560001	560001	560001	560001	560001	0	0
Ratio of Allocations (%)	0.641	0.641	0.641	0.641	0.641	0.585	0.377	0.204	0.000	0.000
Incomes	3589	3589	3589	3589	3589	3277	2110	1144	177	177

Source: JICA

Table 3.7.2(1) Financial Statements for Environmental Fund

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Income Statement										
Revenue	0	0	0	0	3304	3304	3304	3304	3304	3304
Operation and Maintenance	0	0	0	0	177	177	177	177	177	177
Depreciation	0	0	0	0	13	13	13	13	13	13
Payment of Interest	0	0	0	257	728	1170	1579	1470	1353	1229
Expenditure	0	0	0	257	919	1360	1770	1660	1543	1420
Profit before Tax	0	0	0	-257	2385	1944	1534	1644	1761	1884
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	0	0	0	-257	2385	1944	1534	1644	1761	1884
Funds Statement										
Profit after Tax	0	0	0	-257	2385	1944	1534	1644	1761	1884
Loans	3602	6805	6805	6805	0	0	0	0	0	0
Government Budget	0	0	0	0	0	0	0	0	0	0
Depreciation	0	0	0	0	13	13	13	13	13	13
Sources	3602	6805	6805	6547	2399	1957	1548	1657	1774	1898
Provision of Loans	3602	6805	6805	6805	0	0	0	0	0	0
Payment of Principal	0	0	0	254	750	1275	1832	1942	2059	2182
Working Capital	0	0	0	-512	1649	682	-285	-285	-285	-285
Applications	3602	6805	6805	6547	2399	1957	1548	1657	1774	1898
Balance Sheet										
Liabilities	3819	11261	19150	27000	27142	26325	24492	22550	20491	18309
Capital	0	0	0	-257	2128	4072	5606	7250	9011	10895
Liabilities and Capital	3819	11261	19150	26743	29269	30397	30098	29800	29502	29204
Current Assets	0	0	0	-512	1137	1819	1534	1249	964	679
Fixed Assets	3819	11261	19150	27254	28133	28578	28565	28551	28538	28525
Assets	3819	11261	19150	26743	29269	30397	30098	29800	29502	29204

Source: JICA

Table 3.7.2(2) Financial Statements for Environmental Fund

(Unit: thousand US$)

No.	11	12	13	14	15	16	17	18	19	20
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Income Statement										
Revenue	3304	3304	3304	3304	3304	3304	3304	3304	0	0
Operation and Maintenance	177	177	177	177	177	177	177	177	177	177
Depreciation	13	13	13	13	13	13	13	13	13	13
Payment of Interest	1099	960	813	657	491	316	161	55	0	0
Expenditure	1289	1150	1003	847	682	506	351	245	190	190
Profit before Tax	2015	2154	2301	2457	2622	2798	2953	3059	-190	-190
Tax	0	0	0	0	0	0	0	0	0	0
Profit after Tax	2015	2154	2301	2457	2622	2798	2953	3059	-190	-190
Funds Statement										
Profit after Tax	2015	2154	2301	2457	2622	2798	2953	3059	-190	-190
Loans	0	0	0	0	0	0	0	0	0	0
Government Budget	0	0	0	0	0	0	0	0	0	0
Depreciation	13	13	13	13	13	13	13	13	13	13
Sources	2028	2167	2314	2470	2636	2811	2966	3072	-177	-177
Provision of Loans	0	0	0	0	0	0	0	0	0	0
Payment of Principal	2313	2452	2599	2755	2921	2584	1772	912	0	0
Working Capital	-285	-285	-285	-285	-285	27	1194	2160	-177	-177
Applications	2028	2167	2314	2470	2636	2811	2966	3072	-177	-177
Balance Sheet										
Liabilities	15996	13543	10944	8189	5268	2684	912	-0	-0	-0
Capital	12910	15064	17365	19822	22444	25242	28195	31254	31063	30873
Liabilities and Capital	28906	28607	28309	28011	27713	27926	29107	31254	31063	30873
Current Assets	394	109	-176	-460	-745	-718	475	2636	2459	2282
Fixed Assets	28511	28498	28485	28471	28458	28645	28631	28618	28605	28591
Assets	28906	28607	28309	28011	27713	27926	29107	31254	31063	30873

Source: JICA

Table 3.8.1 Outlays and Budget Allocations for Institutional Measures (Exc. E. F.)

(Unit: thousand US$)

No.	1	2	3	4	5	6	7	8	9	10
Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Operation & Maintenance	0	0	116	116	116	116	116	116	116	116
Payment of Interest	0	0	0	24	46	43	40	36	33	29
Replacement	0	0	0	0	0	0	0	0	0	0
Payment of Principal	0	0	0	23	48	51	54	57	60	64
Outlays	0	0	116	162	209	209	209	209	209	209
Budget (million US$)	218	227	236	246	255	266	276	287	299	311
Ratio of Allocations (%)	0.000	0.000	0.049	0.066	0.082	0.079	0.076	0.073	0.070	0.067
Budget Allocations	0	0	116	162	209	209	209	209	209	209

No.	11	12	13	14	15	16	17	18	19	20
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Operation & Maintenance	116	116	116	116	116	116	116	116	116	116
Payment of Interest	26	22	17	13	8	3	0	0	0	0
Replacement	0	0	0	0	0	329	329	0	0	0
Payment of Principal	68	72	76	81	86	44	0	0	0	0
Outlays	209	209	209	209	209	491	445	116	116	116
Budget (million US$)	323	336	350	364	378	393	409	425	442	460
Ratio of Allocations (%)	0.065	0.062	0.060	0.058	0.055	0.125	0.109	0.027	0.026	0.025
Budget Allocations	209	209	209	209	209	491	445	116	116	116

Source: JICA

Table 3.9.1 Cost Benefit Streams -
Five Projects Combined

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:US$ thousand)

NO.	YEAR	CC	OM	CS	BF	CF
1	1998	2986	0	2986	0	-2986
2	1999	6499	0	6499	0	-6499
3	2000	14177	0	14177	0	-14177
4	2001	16317	0	16317	0	-16317
5	2002	14732	0	14732	0	-14732
6	2003	10012	13	10025	840	-9185
7	2004	0	1924	1924	71531	69607
8	2005	0	1924	1924	7229	5305
9	2006	0	1924	1924	7501	5577
10	2007	0	1924	1924	7786	5862
11	2008	0	1924	1924	8085	6161
12	2009	0	1924	1924	8397	6473
13	2010	0	1924	1924	8725	6801
14	2011	0	1924	1924	9067	7143
15	2012	0	1924	1924	9426	7502
16	2013	867	1924	2791	9802	7011
17	2014	1445	1924	3369	10196	6827
18	2015	4845	1924	6769	10608	3839
19	2016	4833	1924	6757	11040	4282
20	2017	5095	1924	7019	11492	4473
21	2018	3698	1924	5622	11965	6343
22	2019	0	1924	1924	12461	10537
23	2020	0	1924	1924	12980	11056
24	2021	0	1924	1924	13523	11599
25	2022	0	1924	1924	14093	12169
26	2023	0	1924	1924	14689	12765
27	2024	0	1924	1924	15313	13389
28	2025	0	1924	1924	15967	14043
29	2026	0	1924	1924	16651	14727
30	2027	0	1924	1924	17368	15444
31	2028	0	1924	1924	18119	16195
32	2029	0	1924	1924	18905	16981
33	2030	0	1924	1924	19728	17804
34	2031	0	1924	1924	20591	18667
35	2032	0	1924	1924	21493	19569
36	2033	0	1924	1924	22439	20515

SECTOR J

ENVIRONMENTAL ASPECT

10
1-7-55

THE STUDY ON
THE ENVIRONMENTAL IMPROVEMENT PROGRAM OF
THE UPPER AND MIDDLE STREAM OF THE TUY RIVER BASIN

SECTOR J: ENVIRONMENTAL ASPECT

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SECTOR J ENVIRONMENTAL ASPECTS

1. PRESENT CONDITION

1.1 Areas under the Special Administration Regime (ABRAE)

In the Tuy River basin, there exist 12 special administration zones, called Areas under the Special Administration Regime (Areas Bajo Régime de Administración Especial: ABRAE) such as 4 national parks, 2 national monuments, 9 protected areas, 1 potential agricultural development area, and 3 tourist/recreation zones. ABRAE was established in 1983 under the land management law in order to ensure conservation and protection of natural resources as well as environmental improvement.

It is confirmed that in the study area ABRAE consists of 2 national parks, 1 protected zone and 1 tourist/recreation zone (see Fig.J.1.1). Its total covering area is 96,750 ha of land, of which 67,010 ha is in the upper basin and 29,740 ha in the middle basin of the Tuy River. Macarao national park is located in the upper basin covering 2,530 ha which account for about 17% of its total park area, while Guatopo national park located in the middle basin is 29,740 ha accounting for 24%. Protected zone is predominant in the study area. It is estimated at 59,010 ha of land covering about 70% of whole protected zone of Caracas Metropolitan Area, and the land use is strictly limited under the law for the conservation of forest, soil, water and fauna. As for tourist/recreation zone, it can be identified in the uppermost area where Colonia Tovar is symbolically located as a tourist attraction place. Further details are shown below;

(Unit: ha)

Sub-basin	National park	Protected zone	Tourist/recrea-tion zone	Total
Upper stream	2,530	59,010	5,470	67,010
Middle stream	29,740	-	-	29,740
Total	32,270	59,010	5,470	96,750

Source: MARNR, SARETUY Caracas 1989

1.2 General Environmental Conditions of the Study Area

Garbage Disposal Site

There are three garbage disposal sites in the study area, one is on Cerro Pegapega, so called Bonanza located about 40 km south from Caracas, and other two are Limoncito in the upstream of Qda. Guayas and Morocopo in the upstream of Qda. Morocopo. Basically, only domestic refuse is collected and dumped in these sites and

no industrial residue is allowed to be disposed. The location of the sites is shown in Fig.J.1.2 together with aquifer zone.

Bonanza is a large-scaled disposal site receiving 4,000 tons of garbage daily collected from 5 different cities (Alcaldías) of Caracas Metropolitan Area and 4 municipalities (Municipios) in the middle basin of the Tuy River. In this connection, it should be noted that about 95% of total disposable refuse is from Caracas. Bonanza was constructed in 1980 and run by Metropolitan Institute for Urban Cleaning (Instituto Metropolitano de Aseo Urbano: IMAU) until 1993, but now Mancoser has being in charge of management of disposal site since it was founded in 1994 as an enterprise. Thus, it started sanitary business by self-supporting system. According to the information Mancoser owns 168 ha of land which is presumed to be enough capacity for next 20 years.

Taking advantage of topographic feature, collected refuse is disposed in the valley by sanitary landfill method. It is performed in such a way that a stack of garbage is covered with sandy soil at a depth of 30~60cm for every 3m high and well compacted by machinery forming a terrace-typed clod, called a cell. Pipes are installed vertically in the landfill site in order to remove methane generated from the disposed waste.

Oxidation pond is also constructed at the extream end of the landfill site to collect leachate, however, it seems to be not well functioning to retain the liquid for a period required for its proper treatment. It was overflowing the bank and running part of the way through Caño Vegote. Should the situation remains unchanged, it will certainly flow down to the river in the end in the rainy season. It is reported that two monitoring wells are installed in the downstream of the valley, but no record is available since monitoring has not been carried out for many years.

Disposal sites of Limoncito and Morocopo are located in the upstream of the Tuy River basin, each controlled and managed by the municipality of Los Teques and Las Tejerias. Collected refuse is brought here by trucks and just dumped from top of the hill to the valley, and no sanitary measure is taken afterward, so that all garbage is exposed to the air giving out a stench. The volume of disposable refuse is too small to compare with that of Bonanza as it can be proportionate to the population. However, it can not be neglible at all, because the refuse might be carried away down through quebrada in the rainy season and may contaminate the river in consequence. In general, this issue seems to be not public concern yet.

Groundwater

Hydrogeological study of the Tuy River basin was conducted in 1989 under the Directorate General of Land Planning and Management (Dirección General de Planificación y Ordenación del Territorio) as part of SARETUY Program. According to this report, the total number of existing wells in the Tuy River basin is 285, of which 124 are found in Federal District, 152 in Miranda State and 9 in Aragua State. Then, in 1991, Sistema de Información Ambiental Cuenca del Río Tuy, MARNR carried out an inventory survey on existing wells in the same basin, and it has been confirmed that well-dotted area

is located on the right bank in the upper basin, while it can be seen on the left bank in the middle basin.

As a result of the above hydrogeological study, 15 wells have been identified in the alluvium between El Consejo and Las Tejerias, but now this number should be more because it has been confirmed that there are 15 deep wells only in Las Tejerias, all of which are currently in operation for both domestic and industrial use. It is also reported that the maximum discharge is 45 *l*/sec, and the depth varies between 85m and 24m depending on the site. Judging from the fact that the groundwater level is relatively high in this area, it is probably interrelated with the river water. If so, pollution might be in progress for the groundwater too. Therefore, the report emphasizes the need to undertake water analysis work periodically to see the degradation of groundwater quality.

Before 1969, groundwater and quebrada used to be the domestic water sources in such cities as Cua, Ocumare, Charallave, San Francisco de Yare, Santa Teresa and Santa Lucia, but it has been totally changed since Ocumare reservoir started to play a role as new water source, from which people are now benefited by water supply system. Groundwater is, therefore, no longer used for domestic water as it is now being used for mainly irrigation and industry.

There have been 59 wells in this area. Among those the deepest one is 136m, and maximum and average discharges are reported to be 50 *l*/sec and 9 *l*/sec respectively. As for water quality, chloride, sulphate and total dissolved solids (TDS) have been detected from some wells, particularly in Colonia Mendoza, TDS and chloride were remarkably high as showing 4,158 mg/*l* and 1,770 mg/*l*, that is to say, it must be brackish water. Special attention needs to be paid to salt injury if groundwater is used for irrigation.

With regard to coliforms, the report quated from the study result of the Caracas University. The study was conducted from January to February 1987 selecting 5 wells from Charallave and Ocumare de Tuy. It showed such a high value as 460 MPN/100 m*l* at Ceramica Paso Real in Charallave, while it was less than 50 MPN/100 m*l* for the rest of 4 sites.

Fauna and Flora

Under the present environmental conditions in the Tuy River basin, animals's habitat or refuge are limited to only such areas as national parks or some protected zones where the ecosystem remains favorable for them, However, there are still a number of species of mammal, fowl and reptile in both uppe stream and middle stream of the river basin. Those are listed hereunder;

Mammal : Cunaguaro, tigrito, otter, deer, squirrel, mouse, rabit, lapa, sloth, monkey (araguato), etc.

Fowl : Heron, sparrowhawk, falcon, humming bird, macaw, parakeet, zamuro, turtle dove, etc.

Reptile : Serpents (coral, mapanare) iguana, lizard, etc.

Among those, some animals are recognized as endangered speicies and protected under the Washington Convention, 1973 such as cunaguaro, tigrito, otter, deer (venado caramerudo), lapa and falcon (halcón peregrino).

As for aquatic fauna, it is understood that water pollution causes hard conditions for animals to survive. Consequently, only a few kinds of fishes can be observed in the uppermost stream and middle stream. They are identified as catfish (bagre) and corroncho, but species of these animals are not known. No animals are observed between El Consejo and Boca de Cagua because water is extreamly contaminated by the industrial waste and piggery.

Vegetal formation in the study area consists of mainly thicket of less than 5 m high. Predominant species is Guatacare growing as regenerated wood after the natural vegetation cover has been intensively climinated by cutting trees or fires. Hills and mountain foot around cities or roads are represented by the herbaceous feature. The presence of this type of vegetation is closely related to the deforestation caused by human intervention, and it can be seen in the sector of low mountain area between El Consejo and Colonia Tovar or between Cagua and Las Tejerias.

1.3 Deforestation

Deforestation is in progress in nationwide. Statistical data indicates that annual deforestation rate between 1975 and 1988 is estimated at 0.94 %. No data is available on the study area in this connection. However, it is noted that both states of Miranda and Aragua covering upper and middle basins of the Tuy River are facing a problem of losing forest resources.

According to the information from MARNR, the forest coverage area in Miranda State was estimated at 504,257 ha in 1982, but it was reduced to 421,652 ha in 1995, showing 16.4 % of deforestation for the last 13 years, so that annual forest loss will be 6,354 ha or 1.26 %. In the meantime, Aragua State owned 262,478 ha of forest in 1982 and 173,697 ha in 1995 respectively accounting for 33.8 % of loss in forest resources. Annual average deforestation can be calculated at 6,829 ha which is corresponding to 2.6 %. Deatils are tabulated below;

	Miranda State	Aragua State
Forest Area in 1982 (ha)	504,257	262,478
Forest Area in 1995 (ha)	421,652	173,697
Deforested Area (ha)	82,605	88,781
Deforestation Rate (%)	16.38	33.82
Annual Deforestation (ha)	6,354	6,829
Annual Deforest. Rate (%)	1.26	2.60

Source: Balance Ambiental de Venezuela, Apéndice 1996, MARNR

1.4 Regulation and Procedure for Environmental Impact Study

In Venezuela the first environmental impact study was carried out in 1982 by LAGOVEN, a unit of state oil company Petróleos de Venezuela SA, for the project of fuel supply to metropolitan area (Suministro Alterno de Combustible Area

Metropolitana: Proyecto SAAM), and it was duly evaluated and then approved by the committee for environmental impact analysis under MARNR. However, there was no guidance for the study of environmental assessment (EIA), so that the study has not been systematically conducted to comply with any change of environmental conditions resulting from the time lapse between the study period and construction. It is mainly because of the lack of proper management and monitoring system for the significant impact. Under these circumstances, MARNR emphasized the need to prepare a guideline for EIA which can be applicable to all kinds of projects in the country.

In June 1983 EIA guideline was prepared in collaboration with Office of Technical Standards in Sectoral Directorate General of Environmental Administration which is presently split into two Directions such as Directorate General of Environmental Quality (Dirección General de Calidad Ambiental) and Directorate General of Surveillance and Control (Dirección General de Vigilancia y Control).

Regulation on EIA was established in July 1991 under the decree No.1741 including revision of the above guideline. This regulation was amended in April 1992, but in fact the contents and philosophy remained unchanged and it constitutes one of the technical standards of penal law of environment (Ley Penal del Ambiente). Currently this regulation is no longer effective, because it has been revised again and final approval was obtained in the cabinet on March 13, 1996 under the decree No. 1257. The new regulation appeared in an official gazette No. 31946 dated April 25, 1996.

According to the new regulation, there are two different approaches to the study depending on the type of development scheme or activity such as natural resources development and other sector's development scheme. In either case, the study should be concluded to identify significant impact and impact sources by the project including measures to be taken in order to mitigate environmental degradation.

With regard to natural resources development such as mining or oil exploitation project, EIA is required on both exploration stage and operation stage, and approval (Autorización de Afectación de Recursos: AAR) should be obtained from EIA evaluation committee on each stage. It is understood that a long span of period needs to be considered for the development of natural resources. Therefore, environmental impact study should be such a way as proposed in new regulation to cope with environmental changes which may occur as time goes by. Nevertheless, the procedure seems to be more complicated and time consuming as a result.

For any program and activity other than mining or oil development project, EIA shall be conducted in accordance with the procedure shown in Fig.J.1.3.

For any project to be undertaken in the Tuy River basin, EIA committee of Tuy River Basin Agency. is in charge of evaluating environmental impact study. On the other hand, if the project location is out of the said basin, it should be evaluated under the auspices of Directorate General of Environmental Quality of MARNR. The Agency has approved four projects since its foundation of 1993 and three more projects are now in the process of evaluation.

The EIA committee is composed of nine members, of which seven are permanent and two are non-permanent. All members are experts of different field of speciality selected from seven different Directions. Administration and Protection Management (Gerencia de Administración y Resguardo) sends three members to the committee, and one of them is designated as a coordinator. Details are given below;

	Directions concerned
Permanent member :	Vegetation (1) Environmental Plan and Management (1) Soil and Watershed Conservation (1) Plan, Study and Project Management (1) Administration and Protection Management (3)
Non-permanent member :	Environmental Quality (1) Territorial Management (1)

All companies and juridical persons are requested to register in the Agency as a precondition, otherwise no chances are provided for them to be engaged in the work of the Agency. Sor far there are about twenty registered members, but those who are competent enough to deal in specific work such as environmental impact study are supposed to be very limited number.

2. ENVIRONMENTAL IMPACT ASSESSMENT

2.1 General

Environmental Impact assessment is required as part of feasibility study to describe characteristics of the project and potential natural and social impacts resulting from the project implementation. It will also propose a suitable approach to identify significant impact and impact sources, and proper measures should be suggested to mitigate adverse effects of the project. The EIA should be carried out for the proposed projects on the basis of Terms of Reference (TOR) and in accordance with the procedure and guideline of the Republic of Venezuela. The TOR was submitted to EIA evaluation committee of the Tuy Agency together with Document of Intention in the middle of November, 1996. These documents were duly approved on February 21, 1997.

The Proposed projects are defined as the Installation of Sewerage Treatment Plant at Ocumare del Tuy and Las Tejerias, the Construction of Sand Settling Pond at the Water Intake and the Reforestation in Priority Areas. The reforestation project in this case is

considered non-lucrative as it is envisaged to function as a protective measure against soil erosion for the improvement of natural environment of the natural river basin. Judging from the fact that the Environmental Evaluation Standards established under the Decree No.1257 can be applicable to commercial and industrial activities in the forestry sector, the committee has decided that the reforestation project is to be ruled out from EIA. With regard to Sand Settling Pond, EIA is not required, either, by reason of project characteristics and its design scale. However, specific items probably needs to be evaluated from environmental point of view as it is described in the above Evaluation Standards.

Environmental impact study started at the beginning of December, 1996 by Ecodipla Consultores, C.A., a selected local consulting firm duly registered in the Agency, under the direction of JICA study team. The study was conducted to become aware of the present conditions of each project area, and it consists of the analysis of natural environment along the river and the evaluation of social environment in the objective areas. The analytical data and information obtained from such study can be referred to the strategic approach to the environmental management plan as well as monitoring plan.

As for the natural environmental study, sampling points were carefully selected for groundwater, sediment and acquatic biology, taking account of high potential pollution sites and their referential points (refer to Fig.J.2.1). Samples were taken to the laboratory in sealed container immediately after in-situ examination had been carried out for certain specific items. Meanwhile, the social environmental study was conducted by means of questionnaire and direct interview with local people in each project area to evaluate their willingness to participate in the project and also to measure public concern about the improvement of sanitary environment. These studies are summarized as follows;

Natural Environmental Study

- Groundwater analysis: Each sample was taken on December 19, 1996 from the different well located on the riverside in the project area, which is currently used as a source of domestic water. The sample was analyzed in TRAC-BM Laboratorios Ambientales C.A., duly registered in MARNR, to observe if the quality is affected by the intrusion of polluted water. Water quality standards for type 1A can be applied for the groundwater analysis. The results of analysis test and applicable standards are listed in Table J.2.1.

- Sediment analysis: Sampling was carried out on the same day as groundwater from the river bed to detect the contents of heavy metals. Such toxic substances may be attributed to the industrial wastewater which has been discharged into the river and settled on the river bed. The sediment composition was analyzed in the

same laboratory as mentioned in the above item. The results are shown in Table J.2.2.

- Aquatic biology: Field observation and sampling were carried out on January 14 and 15, 1997 along the river for biological analysis. Samples were taken from five different sites, all of which are corresponding to the sediment sampling points. It is important to identify class, type and species of existing aquatic fauna and flora, by which present habitat conditions or river environment may be assessed.

Social Environmental Study

- Land ownership: The study includes the number of project-affected families in terms of land acquisition, present land use and total area of land owned by the affected family.
- Public awareness: The major point is to confirm people's interest in the improvement of sanitary environment and also their reaction or willingness to participate in the project.
- Discharge system: This study was conducted in Las Tejerias and Ocumare del Tuy to investigate present discharge system of domestic wastewater such as sewerage, river, stream, septic tank and so on.
- Public health: Predominant diseases were listed through the interview survey, and special attention was paid to the waterborn diseases in both Ocumare del Tuy and Las Tejerias to evaluate impact of domestic water resources on human health.
- Population, economy: For the basic information on the project area, the study includes population of each area and its growth rate, employment, family size, economy etc.

Based on the study on the present conditions, environmental issue shall be further discussed to identify potential impact and impact sources by the project, regardless of whether it is possitive or negative, and it shall be considered in three different stages such as pre-construction, during construction and post-construction. Should circumstances change in the negative way, some preventive or mitigative measures against adverse effects shall be advised on each stage. In this regard alternative design, location and technology may be reconsidered even though these are carefully analyzed and evaluated from both technical and economical points of view. The study results will certainly reflect on the significant items for the preparation of environmental management plan and monitoring plan.

2.2 Construction of Sewage Treatment Plant in Ocumare del Tuy

Natural Environment

The project location is plain and lowland on the right bank of the Tuy River, which is still surrounded by tropical woods. However, endangered or threatened species of annimals can not be observed as the area has been already developed as one of the major urban centers in the river basin. The city has been developed on the right bank, but it seems that urbanization is now in progress on the left bank, too. In view of these circumstances, only one sample was taken for each study item, because the selected sampling site is considered as the most representative place to measure and evaluate surface water pollution impacts associated with the construction and operation of wastewater treatment facility. Furthermore, urban land use and access problem are also key reasons for not having taken more samples.

(1) Groundwater

The majority of people are benefited by the existing water supply system from Ocumarito which is under the control of Hidrocapital. Groundwater is also being used by some people as a source of domestic water. Sample was taken from a well in Urb. Veraniega located on the left bank of the Tuy River. The test result shows high content of manganese which is nine times as much as standard value. Iron and zinc are also contained in the water indicating 0.66 mg/l and 0.163 mg/l respectively. This may be associated with the soil characteristics of the study area and/or corrosion of installed pipes or strainers for the well. The presence of phosphorus is hardly explained in this study whether organic or inorganic. With regard to other inorganic chemicals, the quality is more or less acceptable for drinking water, and it also satisfy physical and microbiological requirements as shown in column W3 of Table J.2.1.

(2) Sediment Composition

Sampling point is easily identified at site under the Ocumare bridge about 800 m downstream from the confluence with Qda. Charallave. It is light brown and composed of mainly sandy soil. Contents of Cromium, Nickel and Zinc are remarkably high as shown in column S3 of Table J.2.2. These heavy metals are contained in the industrial wastewater discharged into the river or stream and carried downstream with flow. Pollutant sources can be identified as manufacture of metallic product, tannery and synthetic fibers factories, located in Las Tejerias, Cua, Charallave and Ocumare del Tuy. In general sediment pollution tends to be more serious in the lower basin

(3) Biological Consideration

Habitat conditions may be changed to a certain extent depending on the season, but in principle it can be determined based on the present aquatic-echosystem. Sampling site S3 is characterized by the presenece of oligochaeta (phylum Anelida, class Oligochaeta) with density of 4584 individuals/m^2. This benthonic community can be observed even in a condition of 1 mg/l of

dissolved oxygen, so that it may be considered as an indicator of organic pollution. The more water is polluted, the more oligochaeta is present.

Cyanobacteria oscillatoria is an only existing fitoplankton in the water with density of 13 cells/*ml* feeding on nitrogen. However, it is not in favorable condition for zooplankton to survive.

No algae has been observed due to probably high water turbidity. Meanwhile, from rocks collected from the riverbed, some organisms have been found and identified as oligochaeta, larvae of insects such as dragonfly (subclass Pterygota, order Odonata), diptera, mollusc gastropoda (genus Goniobasis sp) and flatworm called platyhelminthes (class Turbellaria, order Temnocephalida).

No fishes have been observed during the field investigation in terms of necton. However, a few kinds of fishes were caught at the same site in last dry season and then confirmed that they were catfish and corroncho (local name), but these species could not be identified. Particular habitat requirement for these species can be associated with the presence of biodegradable organics unless anoxic condition.

Social Environment

As basic approach to the study on social aspects, field survey was carried out to assemble available information through questionnaire to the families and direct interview with the chief of each resident association in the community. The questionnaire covers about 10% of total number of families in the study area. The study result on each subject is summarized as follows;

(1) Proposed Land Situation

The location of proposed land is adjacent to Hacienda Santa Ana on the right bank of the Tuy River. The land is now owned by National Housing Institute (Instituto Nacional de la Vivienda: INAVI) for future housing development, but it still remains undeveloped and inactive. According to the master plan prepared in 1977, this 50 hectores of land is planned for residential area allowing for 300 people/ha. As landholder is government entity, it seems to be not difficult to acquire the land properly for the project.

(2) Public Awareness and Concern about Sanitary Environment

People are apathetic to the river pollution, thinking that they are not directly affected by the polluted water. because surface water resources have been developed to install water supply system through Ocumarito reservoir, which is practically covering water consumption demand of major part of the city. and groundwater was also developed as a source of domestic water. Under these circumstances, the river degradation is not public concern yet, even though their lives were once dependent upon the river about 30 years ago, playing multifunctional roles to the human life. Some people realize that environment degradable situation is due to wastewater discharge, however, no

measure has been taken. It should be noted that manufacturing industry, known as one of the most significant pollution sources, is also considered as a major employment source to absorb local manpower.

(3) Wastewater Discharge System

Based on the information provided by the Ministry of Urbanization (MINDUR), existing sewage system covers about 541 ha of land accounting for 64 % of total urban area, and the number of beneficiaries is estimated at 44,000 corresponding to 75 % of the total population. Wastewater is directly discharged into the river by gravity with pipes of different sizes (0.7 and 0.3 m in diameter). As a result of survey, 95 % of questionnaired families are provided with toilet, wheras only 43 % are with wash basin. This situation becomes more serious in barrio Simon Bolivar where 54 % of families have no toilet. The questionnaire shows that 18.5 % of families discharge wastewater to quebrada or streams and 32 % of those are to the urban drainage system.

(4) Human Health

Information on predominant diseases was available in the hospital of Ocumare del Tuy. However, it covers only whole territory of municipality of Tomas Lander for the last 2.5 yeas, and no information is available on small district level. Total number of morbidities is reported to be 95,152 cases in 1994 and 116,469 cases in the middle of 1996, representing about 22 % of increase. In the meantime, waterborn diseases are increased from 24,055 cases to 26,456 cases in the same period accounting for 10 % up. Statistic data shows that infectious and parasitical cases are in the first rank in terms of water-related disease, followed by skin or subcutaneous tissue and digestive organ.

(5) Other Considerations

The population is now estimated at 80,000 in Ocumare del Tuy, and its gender proportion is represented as 97 women to every 100 men. An average family is composed of 4.56 persons. Unemployment rate is estimated at 50.9 % of the total population at the ages between 14 and 60. One of the social characteristics is that employment opportunity is concentrated on urban center, and basically, manufacturing industry, electricity, water and gas, construction and public services are considered to be the major economic constituents in this area.

2.3 Construction of Sewage Treatment Plant in Las Tejerias

Natural Environment

Las Tejerias has been developed as commercial and industrial area on the left bank of the Tuy River, while the right bank remains under-developed due to topographic restriction. The location of wastewater treatment plant is proposed to be on the right bank nearby the river since it is an only available land to meet both technical and economic requirements. Two samples were collected in the study area, one from industrial sector in the upstream and the other one from the east side edge of the same industrial zone at the confluence with Qda. Morocopo. These samples may represent present conditions on how much river environment is affected by hazardous wastewater.

(1) Groundwater

Samples were properly taken from pozo Textilan (W1) and pozo Morocopo (W2), from which water is supplied for exclusively human consumption. Both are deep wells being 60 m deep each. The former was constructed in 1991 and its flow rate is about 30 *l*/sec, while the latter in 1988 with 25 *l*/sec. Station W1 is showing remarkable grounwater characteristics indicating high concentrations of calcium (480 mg/*l*) and total phosphorus (11.2 mg/*l*). The main reason is probably geological conditions of the study area. Nevertheless further study needs to be carried out to examine if organic phosphorus is contained. Chemical agent is added in the reservoir tank in order to remove hardness before distributing water to the residents. Station W2 is also characterized by high concentration of total phosphorus, but more attention should be paid to the fact that total cromium has been detected from the sample, showing 0.107 mg/*l* which is over the allowable limit of 0.05 mg/*l*. As a result of such an analysis, groundwater is likely affected by the wastewater of various industries such as tannery, textile, metallic products and so on. It should be noted that more detailed study is required in earlier stage possible to analyze concentration of hexavalent which is known as a toxicant to the human health.

(2) Sediment Composition

Sample collected from S1 is dark brown sandy material, while that of S2 is somewhat granulated and grayish color. The distance between these two points is approximately 1,700 m, which is just covering south border line of industrial zone. Taking a look at Table 3.12.2 the contents of heavy metal are higher in almost all parameters belonging to the station S2 as compared with S1, especially lead and copper, which represent remarkably high concentrations in the station S2 such as 9.17 mg/*l* and 12.80 mg/*l* respectively, while these are less than 0.01 mg/*l* and 2.71 mg/*l* in the station S1. The increase of these toxic substances is apparently attributed to the industrial waste. In this regard paint and metallic product factories are identified as pollution sources.

(3) Biological Consideration

In station S1 Anelida Oligochaeta is predominant benthos with density of 97,052 individuals/m^2, followed by larvae of insects (57 individuals/m^2). In station S2, however, the presence of organisms has not been observed due to anoxic conditions in the river bed. The stream-bottom echosystem seems to be extremely unfavorable at the confluence point with Qda. Morocopo.

With regard to fitoplankton only Cyanobacteria Oscillatoria, so called green-blue algae has been detected from both stations with a density of 13 cells/*ml*. The presence of this species may represent high concentration of nitrogen in the water, and such low density and diversity are also related to high turbidity of water. No zooplankton is observed in the study area under the present biological surface-water characteristics.

Although organisms are hardly observed in the river bottom, various species of them could be found from rocks collected from the river. This can be explained in such a way that rocks near the surface of water provide them with preferable habitat conditions due to the higher concentration of dissolved oxygen. These organisms are identified as Anelida Oligochaeta of the family Tubifidae, Nematodos (class Adenophorea), larvae of insects such as dragonfly (Pterygota Odonata), diptera (Pterygota Diptera), mollusc gastropoda (Geniobasis sp) and platyhelminthes (Turbellaria Temnocephalida).

Water quality is so degraded that present aquatic-echosystem does not allow necton to provide suitable habitat or refuge. Consequently, no fishes can be observed in the study area.

Social Environment

(1) Proposed Land Situation

The proposed land is located at Hacienda Guaremal on the right bank of the Tuy River and owned by a single private person. The total area is estimated at 20 hectares of land, of which about 8 hectares will be required for the wastewater treatment plant. Practically the land is not used for specific purposes, but it is allowed to be developed only for public services. Landowner is now in a position to proceed to the negotiation with any responsible agency or institution on selling his property.

(2) Public Awareness and Concern about Sanitary Environment

People are more concerned about sanitary environment as compared with the case of Ocumare del Tuy. An oxygen pond was once constructed on the left bank of the Tuy River in the community of Los Jabillos in an effort to improve wastewater disposal system. At present it is out of function, because residents of the said community strongly protested against the pond for the disagreeable stench. People's protest is further generated against sand quarry company in barrio Simon Bolivar, demanding the installation of proper

treatment plant. In an interview or questionnaire survey, they show a positive reaction to participate in the project.

(3) Wastewater Discharge System

According to Urban Management Plan (Plan de Ordenacion Urbanistica: POU) prepared by MINDUR in 1991, wastewater is discharged into two different types of sewage system, one for industry and the other type for domestic use. The covering rate is nearly 69 % of total population. However, these systems are not in full operation due to canal's deterioration and lack of maintenence. In an answer to the questionnaire, it is understood that domestic wastewater is directly discharged into open canal or natural stream by about 18 % of families, but this figure may vary depending on sectors. Anyhow, such liquid flows down and joins the river regardless of whether or not sewage systems exist.

(4) Human Health

Information on outbreak of diseases in the municipality of Santos Michelena was assembled in regional sanitary station in La Victoria. It is available only for the last 3 years. These data are computerized on each district level as well as community level. Waterborn diseases occurs frequently in the munnicipality, and 4,603 cases are reported in 1994. This number reduced to 3,725 in 1995 and then increased to 5,273 in 1996. No reasons are explained for the fluctuation of numbers. Diarrhea ranks first in water-ralated disease followed by gastric complications. This may be attributed to the high concentration of $CaCO_3$ or calcium in groundwater.

(5) Other Considerations

As a result of questionnaire to the local families carried out in January 1997, unemployment rate is estimated at 44 % of the population of Las Tejerias at the age of 14 to 60. It seems to be even more higher in some barrios such as El Estado-El Beisbol (70%), San Luis (58%) and Pueblo Nuevo (58%). An average family size is composed of 4.7 persons, which is the same as national level. There are two major activities in terms of local economy such as manufacturing industry and transport/comunications.

2.4 Construction of Sand Settling Pond at the Water Intake

Since project is not likely to affect natural and social environment, significant impact is not easily predicted. Nevertheless, study was conducted to evaluate some specific items which are potentially susceptible to environmental degradation, and it is not to cope with EIA requirements. Land acquisition was considered to be only significant social impact source, but now it is not the subject to be discussed, since the proposed land is owned by Hidrocapita. Under such circumstances, attention was paid to the study of natural environment rather than social environment.

Natural Environment

Project site is located on the opposite side to the present water intake facility of Hidrocapital and isolated from the urban center of San Francisco de Yare. Sampling was carried out in two sites, one at San Antonio 1 km upstream from the intake (S4) and the other one at Hacienda Sitio 2 km downstream from the intake weir (S5), to study sediment composition and aquatic biology. Details are as follows:

(1) Sediment Composition

As presented in Table J.2.2, it is obvious that sediment contains outstandingly high concentration of heavy metals in both stations of S4 and S5, at downstream of the study area. Sediment is easily accumulated at the low and flat zone with all materials carried from upstream. In addition, the station S4 is close to the weir blocking the flow to facilitate water intake unless river discharge is high like in rainy season. This may cause high concentration of heavy metals in sediment. But station S5 is not the same situation, as it can be explained on the assumption that the silty sedement is discharged back to the river from the existing sand settling pond of Hidrocapital.

(2) Biological Consideration

Benthonic community is dominated by the presence of Oligochaeta in both stations, but its density is lower in more bio-degraded stream bottom. In station S4, for example, it is 226 individuals/m^2, while in station S5 it reduced to 170 individuals/m^2. With regard to plankton, cells have not been observed in the sample probably because of high turbidity of water. However, there are bacteria in the same sample, of which type could not be determined.

The presence of Perifiton, organisms of which habitat is associated with aquatic plant or rocks in the river, was confirmed to be the same as other stations. These are Anelida Oligochaeta, larvae of insects such as dragonfly, diptera, platyhelminthes and so on.

Fishes could not be observed in the course of field investigation, but in an interview with local people, catfish can be observed in the study area during dry season when turbidity becomes less.

2.5 Predictable Impact and Mitigative Measure

Impact prediction is based on all activities relating to the project implementation. Considering project characteristics, it has to lead to possitive way in improving present environments in the Tuy River basin. Nevertheless, adverse impacts can be also predicted in the process of implementation, and proper measures should be taken to protect or minimize negative effects accordingly. In parallel, impact significance is evaluated on each predictable item, of which results are described as follows;

Impact significance	Predictable impact

High	:	Illegal land use, Generation of stench and insects, Sludge
Moderate	:	Traffic congestion, Water quality of the Tuy River, Sediment
Low	:	Noise, Dust, Aquatic biology

Illegal land use in the project site may occur sometime if proposed location is reluctantly controlled by the responsible agency to protect against invasion of the third persons. It is therefore considered as a significant impact in both pre-construction stage and post-construction stage. It is advisable to fence around the construction site soon after the land has been legally acquired, and then security guard should be permanently stationed in the site to keep the land from entering unauthorized persons.

Disagreeable smell and insects may be generated from the sewerage treatment plant, so that trickling filter system is proposed in the project to reduce these adverse effects to the minimum possible, and it can be emphasized that operation and maintenence of the plant should be rather important in terms of mitigation measure. Sludge produced in the treatment plant can be used for agricultural compost or may be disposed in landfill site at Bonanza. These ideas are based on the assumption that contents of hazardous materials are within the allowable limits (Decree No.2211).

During construction period, traffic congestion should be avoided in order not to create any inconvenience to the residents. Work schedule and number of mobilized vehicles should be previously informed to the local Government as well as Tuy Agency for the approval, and contructor should assume the responsibility for traffic control of access road, construction site and other project-affected area. Water quality of the river and sediment are also assessed as negative impacts in construction stage. Both of them are determined to be moderate in significance category, because under the present circumstances, these qualities are already too degraded to identify as significant impact, and adverse impact may be easily controllable if the construction is properly managed.

Minor impacts are predicted for noise and dust during construction stage because project location is relatively away from residential area. However, proper measure should be taken to satisfy requirements specified in Decree No.2217 and No.638 respectively. Public consensus is absolutely necessary about the project prior to the construction, and for the noise control, work schedule should be prepared in such a way that the operation of heavy equipment is limited to the daytime only. For the dust control, attention should be drawn to the earth-moving work during dry season. Watering may be required for access road and for excavation and filling works, too. It is also important to cover soil materials with sheet while transporting from and to the construction site. With regard to aquatic biology it may have some adverse impact during construction due to spilt soil or construction scrap, so that protective net or fence should be placed to keep the river from entering bio-degradable materials. Predictable impacts and mitigation measures are summarized in Table J.2.3.

2.6 Environmental Management Plan

Predictable impacts and appropriate measures as described in the previous section can be put to practical use for the preparation of environmental management plan. Managing item is specified in each stage of project implementation describing impact source, measuring standard and strategic approach, and management location and responsible organization should be also mentioned in this regard. The overall view of environmental management plan is shown in Table J.2.4 (Sewerage Treatment Plan) and Table J.2.5 (Sand Settling Pond).

Pre-Construction Stage

Public protest and demonstration may arise if project location is not mutually agreed between project executor and residents or land acquisition is not successfully achieved. Public hearing should take place in project-affected communities prior to the project implementation, and land issue should be discussed to settle the problem through negotiation with landowner(s).

Construction Stage

Impact source will be mainly civil works for the project implementation. Noise, dust and traffic congestion are controllable to some extent by adjusting working hour and number or speed of mobilized vehicles. It is also important to follow respective standard determined under the presidential decree. On the other hand, river environment represented by water quality, sediment and aquatic biology can be controlled by means of construction management in an effort not to worsen present situation.

As a matter of course, the project creates employment opportunities. An effective action needs to be taken to recruit local manpower to the maximum possible under the guidance of local Government as well as Tuy Agency or Hidrocapital. Employment generation will lead to the increase in family income and may help vitalize local economy as a result.

Post-Construction Stage

All items to be managed on post-construction stage are basically related to the operation and maintenance of facility. Tuy Agency should take the initiative in environmental management for by-products of the treatment plant such as stench, insects and sludge. Landfill site at Bonanza may be designated as a potential disposal place for the sludge if its composition meets requirement which is determined under Decree No.2211 (maximum allowable concentration of toxic substances for leachate). For the strategic approach to the management, competent personnel should be placed at site to be engaged in operation and maintenance of the facility, and thereby systematical function can be achieved to satisfy minimum requirement for the prevention of environmental degradation.

For the control of illegal land use, Tuy Agency or Hidrocapital should make every efforts to have public comprehension about the projet in collaboration with local

Government and regional Government as well. Thus, particular attention needs to be paid to the land issue not to create any social impact in negative way.

2.7 Environmental Monitoring Plan

Based on the identification of natural and social environmental impacts, monitoring should be carried out as follow-up action after facility construction. In general, it can be undertaken in such a way that Tuy Agency or Hidrocapital should establish monitoring system at an early stage possible and be engaged in regular site inspection, field measurement and sample analysis. Besides these fundamental activities, monitoring location, frequency and duration should be determined taking account of significance and effectiveness on each monitoing item. Matrix of environmental monitoring plan is presented in Table J.2.6 (Sewerage Treatment Plant) and Table J.2.7 (Sand Settling Pond).

Natural Environmental Aspects

Tuy Agency should assume the responsibility for monitoring such items as sediment, aquatic biology, surface water and groundwater. Sampling is required every 6 months at the selected point for EIA to evaluate how much aquatic environmental quality is improved through the project. Monitoring duration is desirable to cope with the target year of mid-term program. Sample analysis work should include all parameters employed in EIA. Moreover, COD for groundwater and Cadmium (Cd) for sediment are suggested to be included for the monitoring. With regard to sampling and quality analysis of surface water, it is advisable to coordinate with GTZ in promoting monitoring work.

In establishing monitoring plan, it is also important to focus on by-products of treatment plant. Consequently, wastewater quality should be checked weekly at the inlet and outlet of the plant, trying to detect especially concentration of heavy metals. It may certainly help evaluate effectiveness and function of treatment system in both industry and proposed plant, and it will provide determinant factor to judge if sludge composition is allowable as a disposable material for the landfill site. No limit is defined as to monitoring period for the by-products.

Social Environmental Aspects

Tuy Agency is in charge of monitoring noise, dust and traffic congestion during construction period. It should be carried out every once a month at construction site, relevant communities and road where potential impact is considered high due to the operation of equipment. Information on water-born diseases should be collected tri-monthly from Distrito Sanitario No.2 since groundwater quality is expected to be improved by the subject project on the assumption that surface water is interrelated with groundwater. Furthermore, impact study on stench and insects needs to be conducted periodically based on the public opinion and interview.

Hidrocapital, executing agency for the project of sand settling pond, takes charge of monitoring work for water supply operation and turbidity at pre-treatment plant. This is to evaluate the function of improved water intake facility as well as water supply

system. Monitoring frequency is proposed to be once a week for turbidity and once every three months for water supply operation.

Illegal land use of project site is one of the major items in monitoring plan. Acquired land should be properly managed and controlled by Tuy Agency or Hidrocapital, and no trespassing should be allowed for any unauthorized person. In this regard monitoring has no limit of duration.

Table J.2.1 Results of Water Quality Test

Parameter	Water Quality Standard (1A)	Groundwater Sampling Points		
		W1	W2	W3
pH	6.0~8.5	6.71	6.96	6.85
Turbidity	25 NTU	0.00	0.00	0.00
E.Conductivity	- μS/cm	781	526	295
Real Colour	50 Pt-Co	0.00	0.00	0.00
Apparent Colour	- Pt-Co	<5.0	<5.0	<5.0
Total Phosphorus	- mg/l	11.20	6.22	3.19
Total Nitrogen	- mg/l	<0.021	<0.021	<0.021
Ammoniac Nitrogen	- mg/l	<0.021	<0.021	<0.021
Nitrite+Nitrate	10.0 mg/l	<0.01	<0.01	<0.01
Manganese(Mn)	0.1 mg/l	<0.05	<0.05	0.94
Hardness($CaCO_3$)	500 mg/l	1,198	149	138
Calcium	- mg/l	480.00	59.86	55.43
Iron(Fe)	1.0 mg/l	<0.01	<0.01	0.66
Chromium(Cr)	0.05 mg/l	<0.01	0.107	<0.01
Cadmium(Cd)	0.01 mg/l	<0.001	<0.001	<0.001
Lead(Pb)	0.05 mg/l	<0.01	<0.01	<0.01
Zinc(Zn)	5.0 mg/l	0.23	0.189	0.163
Total coliform	2,000MPN/100ml	<1,000	<1,000	<1,000

Note: Samples were taken from Las Tejerias(W1 and W2) and Ocumare del Tuy(W3) as illustrated in Fig.J.1.4.
Mark (-) in the colmun Standard means no standard value

Table J.2.2 Results of Sediment Analysis

(Unit: mg/kg)

Parameter	Sampling Points				
	S1	S2	S3	S4	S5
Chromium(Cr)	3.14	3.08	5.77	1.04	8.53
Nickel(Ni)	5.05	7.39	11.64	14.32	17.77
Lead(Pb)	<0.01	9.17	<0.01	3.71	6.40
Copper(Cu)	2.71	12.80	3.35	4.26	5.74
Mercury(Hg)	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc(Zn)	11.52	15.98	17.57	17.43	23.57

Note: Samples were taken from Las Tejerias(S1 and S2), Ocumare del Tuy(S3), San Antonio(S4) and Hda. Sitio(S5).

Table J.2.3 Predictable Adverse Impacts and Mitigation Measures

Predictable Impact	Impact Stage	Assessment of Impact Significance	Mitigation Measure
Illegal land use	Pre-construction Post-construction	High	Proposed land should be under strict surveillance of Tuy Agency or local Government to protect against illegal land use or invasion of third persons. Fencing and employment of security guard are advisable in this regard.
Noise	Construction	Low	Work schedule should be informed in public through local Government, and care needs to be taken to the heavy equipment, of which operation should be limited to only daytime.
Dust	Construction	Low	Watering is desirable for earth moving work or access road. Soil materials should be covered with sheet.
Traffic congestion	Construction	Moderate	Number of mobilized equipment and vehicles should be controlled taking account of present traffic conditions and proposed work schedule.
Water quality of the river	Construction	Moderate	Protective net or fence should be placed on the river edge to keep the stream from entering spilt soil and construction of scrap or waste.
Sediment	Construction	Moderate	Sediment accumulated in the Tuy River channel should not be used for construction materials. It is required to be disposed at designated site.
Aquatic biology	Construction	Low	Same measure as mentioned in the item "water quality" is required not to worsen present stream-ecosystem in the course of construction.
Generation of stench and insects	Post-construction	High	Competent personel should be placed to deal with proper operation and maintenance of sewerage treatment plant
Sludge	Post-construction	High	Sludge produced in treatment plant should be disposed in landfill site at Bonanza on condition that its composition is not detrimental to the environment.

SECTOR J

TABLES

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Total Nitrogen	- mg/l	<0.021	<0.021	<0.021
Ammoniac Nitrogen	- mg/l	<0.021	<0.021	<0.021
Nitrite+Nitrate	10.0 mg/l	<0.01	<0.01	<0.01
Manganese(Mn)	0.1 mg/l	<0.05	<0.05	0.94
Hardness($CaCO_3$)	500 mg/l	1,198	149	138
Calcium	- mg/l	480.00	59.86	55.43
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Chromium(Cr)	0.05 mg/l	<0.01	0.107	<0.01
Cadmium(Cd)	0.01 mg/l	<0.001	<0.001	<0.001
Lead(Pb)	0.05 mg/l	<0.01	<0.01	<0.01
Zinc(Zn)	5.0 mg/l	0.23	0.189	0.163
Total coliform	2,000MPN/100ml	<1,000	<1,000	<1,000

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Noise	Construction	Low	Work schedule should be informed in public through local Government, and care needs to be taken to the heavy equipment, of which operation should be limited to only daytime.
Dust	Construction	Low	Watering is desirable for earth moving work or access road. Soil materials should be covered with sheet.
Traffic congestion	Construction	Moderate	Number of mobilized equipment and vehicles should be controlled taking account of present traffic conditions and proposed work schedule.
Water quality of the river	Construction	Moderate	Protective net or fence should be placed on the river edge to keep the stream from entering spilt soil and construction of scrap or waste.
Sediment	Construction	Moderate	Sediment accumulated in the Tuy River channel should not be used for construction materials. It is required to be disposed at designated site.
Aquatic biology	Construction	Low	Same measure as mentioned in the item "water quality" is required not to worsen present stream-ecosystem in the course of construction.
Generation of stench and insects	Post-construction	High	Competent personel should be placed to deal with proper operation and maintenance of sewerage treatment plant
Sludge	Post-construction	High	Sludge produced in treatment plant should be disposed in landfill site at Bonanza on condition that its composition is not detrimental to the environment.

Table J.2.4 Environmental Management Plan for the Installation of Sewerage Treatment Plant at Ocumare del Tuy and Las Tejerias

Managing Item	Source of Impact	Measuring Standard of Impact	Managing Approach	Management Location	Managing Agency Concerned
(Pre-Construction Stage)					
-Social unrest	-Project location -Land acquisition	-Compensation -Public protest/ demonstration & project disturb	-Negotiation -Public hearing -Presidential decree No.184 (Expropriation Law)	-Project site -All project-affected communities	-MARNR -Tuy Agency -Local Government -Regional Government
(Construction Stage)					
-Noise	Operation of heavy equipment	Noise level : 65 dB (Leq) (Decree No.2217)	-Control of number or speed of vehicles/ equipment -Working hour -Equipment operators	-Residential area -School, clinic	-Tuy Agency -Local Government
-Air pollution and traffic congestion	-Mobilization of equipment -Civil works	-Quality standard (Decree No.638) -Traffic congestion frequency/duration	-Covering materials with sheet -Watering road -Selection of spoil site	-Construction site -Public road & access road	-Tuy Agency -Local Government
-Water quality of the river	All civil works relating to the project	Water quality standard according to Decree No.883	-Effort to minimize spilt soil into the river -Protective net at downstream direction	-Construction site -Sewage pipe setting location	-Tuy Agency
-Sediment	Earth works (embankment / filling)	Contents of Cr, Ni, Pb Cu and Zn in sediment	-No use of such materials for embankment -Proper method of disposal in dumping site	Construction site	-Tuy Agency
-Aquatic biology	Embankment / filling for flood protection	Presence and density of benthos, plankton and nekton	-Effort to minimize degradation of water quality -Preservation of natural ecology	Tuy river at Project site (sampling point as determined in EIA)	-Tuy Agency
-Employment and economic growth	Project implementation	-Willingness to participate in project -Increase in family income	Recruitment of local manpower	Municipalities of Santos Michelena and Tomas Lander	-Tuy Agency -Local Government
(Post-Construction Stage)					
-Illegal land use of project site	-Project location -Land acquisition	-No. of squatters -Illegal land use	-Effort to gain public comprehension -Control of illegal land use	Proposed site for sewerage treatment plant	-MARNR -Tuy Agency -Local Government -Regional Government
-Generation of stench and insects	Sewerage treatment plant	Public complaint, protest and reaction	-Treatment method and system -Proper operation and maintenance	Sewerage treatment plant	-Tuy Agency
-Disposal of sludge	Sewerage treatment plant	Sludge composition (contents of toxic substances)	-Sludge disposal system -Proper operation and maintenance	-Final disposal site -Sewerage treatment system	-Tuy Agency -Mancoser -Local Government
-Sewage canals/pipes	Domestic/industrial wastewater	Function of sewerage system	-Proper maintenance of sewerage network -Educating people	Each community concerned	-Tuy Agency -Local Government

Table J.2.5 Environmental Management Plan for the Construction of Sand Settling Pond at Water Intake

Managing Item	Source of Impact	Measuring Standard of Impact	Managing Approach	Management Location	Managing Agency Concerned
(Pre-Construction Stage)					
-Social unrest	-Project location	-Compensation -Public protest/ demonstration & project disturb	-Negotiation -Public hearing	-Construction site -All project-affected land	-Hidrocapital -MARNR -Tuy Agency -Local Government
(Construction Stage)					
-Noise	Operation of heavy equipment	Noise level : 65 dB (Leq) (Decree No.2217)	-Control of number or speed of vehicles/ equipment -Working hour -Equipment operators	Village(s) close to project site	-Hidrocapital -Tuy Agency -Local Government
-Air pollution and traffic congestion	-Mobilization of equipment -Civil works	-Quality standard (Decree No.638) -Traffic congestion frequency/duration	-Covering materials with sheet -Watering road -Selection of spoil site	-Construction site -Public road & access road	-Hidrocapital -Tuy Agency -Local Government
-Water quality of the river	All civil works relating to the project	Water quality standard according to Decree No.883	-Effort to minimize spilt soil into the river -Protective net at downstream direction	-Construction site -Water intake facility	-Hidrocapital -Tuy Agency
-Sediment	Earth works (embankment / filling)	Contents of Cr, Ni, Pb Cu and Zn in sediment	-No use of such materials for embankment -Proper method of disposal in dumping site	Construction site	-Hidrocapital -Tuy Agency
-Aquatic biology	All civil works relating to the project	Presence and density of benthos, plankton and necton	-Effort to minimize degradation of water quality -Preservation of natural ecology	Tuy river at Project site (sampling point as determined in EIA)	-Tuy Agency
-Employment and economic growth	Project implementation	-Willingness to participate in project -Increase in family income	Employment of local manpower	San Francisco de Yare and other nearby villages	-Hidrocapital -Local Government
(Post-Construction Stage)					
-Illegal land use of project site	-Project location	-No. of squatters -Illegal land use	-Effort to gain public comprehension -Control of illegal land use	Proposed site for sand settling pond and its surrounding area	-Hidrocapital -MARNR -Tuy Agency -Local Government
-Water intake and pre-treatment facility	Sand settling pond	-Turbidity -Pumping operation	-Introduction of mechanical sand settling system -Proper operation and maintenance	-Sand settling pond -Intake facility	-Hidrocapital -Tuy Agency
-Flushed sediment	Sand settling pond	Volume of flushed sediment	-Flushing operation -Proper maintenance of facility	-Flushing gate -Downstream of intake weir	-Hidrocapital -Tuy Agency

Table J.2.6 Environmental Monitoring Plan for the Installation of Sewerage Treatment Plant at Ocumare del Tuy and Las Tejerias

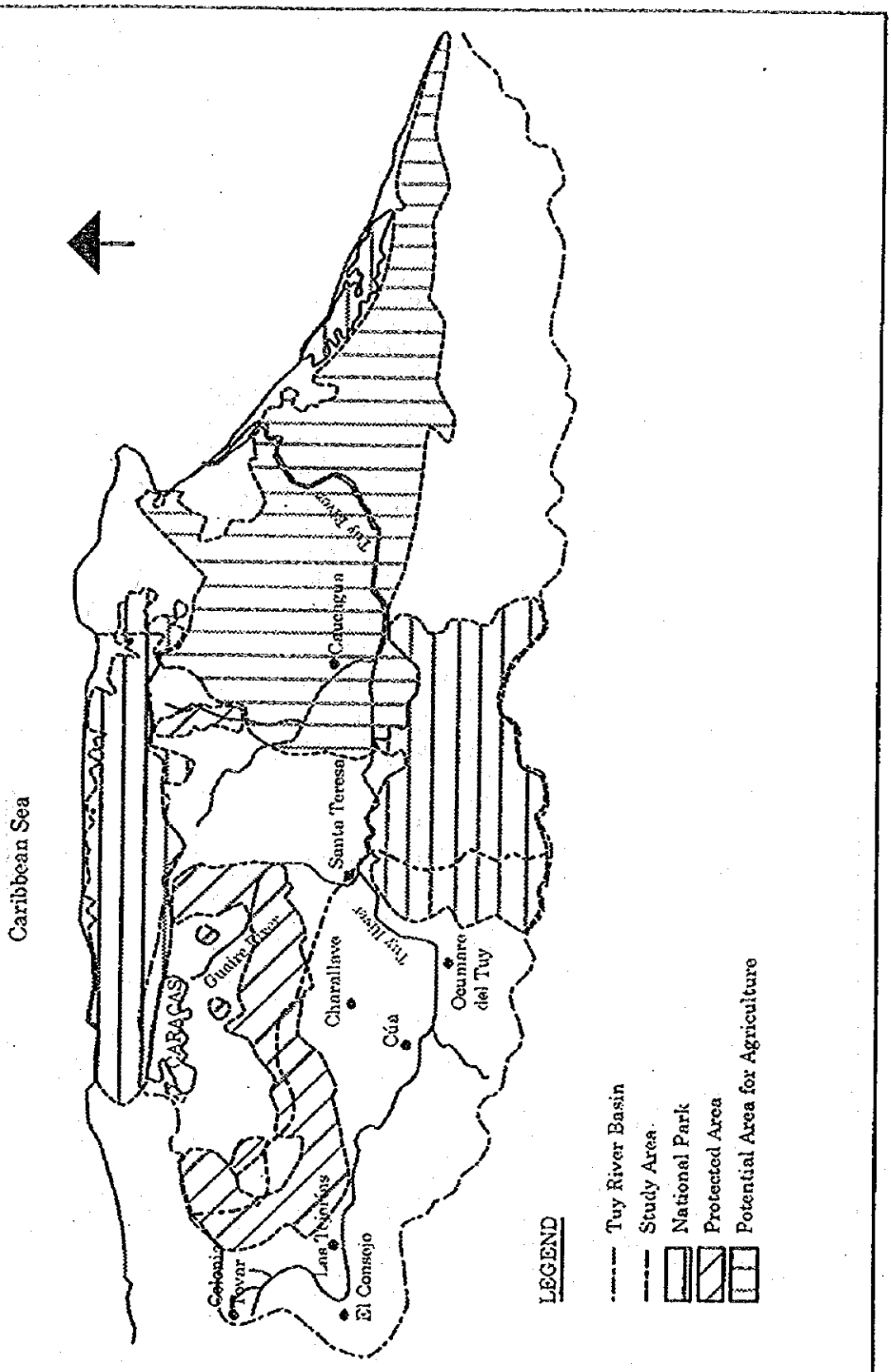
Monitoring Item	Monitoring Method	Location	Monitoring Frequency	Duration	Monitoring Agency
Illegal land use of project site	Field visit and confirmation	Proposed site for sewerage treatment plant	Every 6 months	No limit defined	-MARNR -Tuy Agency -Local Government
Noise	Measured by noise level meter	Residential area close to project site	Once a month	Construction period	Tuy Agency
Dust and traffic congestion	Field inspection and measurement	-Construction site -Urban area	Once a month	Construction period	Tuy Agency
Sediment	Field inspection and measurement	Sampling points as selected in EIA	Every 6 months	Till year 2010	Tuy Agency
Aquatic biology	-Field inspection -Sample analysis	Sampling points as selected in EIA	Every 6 months	Till year 2010	Tuy Agency
Water quality of the Tuy River	Test and analysis of sample waters in laboratory	Sampling points as selected in EIA	Every 6 months	Till year 2010	Tuy Agency
Groundwater quality	Test and analysis of sample waters in laboratory	Sampling points (deep well) as selected in EIA	Every 6 months	Till year 2010	Tuy Agency
Inflow of wastewater	Sample analysis in laboratory	Inlet of sewerage treatment plant	Once a week	No limit defined	Tuy Agency
Outflow of wastewater	Sample analysis in laboratory	Outlet of sewerage treatment plant	Once a week	No limit defined	Tuy Agency
Disposal of sludge	-Field inspection -Sample analysis	-Sewerage treatment plant -Disposal site	Once a month	No limit defined	-Tuy Agency -MARNR
Water supply operation	-Pump operation hours -Volume of pre-treated water	Pre-treatment plant	Every 3 months	Till year 2010	Hidrocapital
Public health	Collection of inform. on waterborn diseases	Distrito Sanitario No.2	Every 3 months	Till year 2010	Tuy Agency
Generation of stench and insects	Public opinion and field inspection	-Sewerage treatment plant -Residential area	Every 3 months	Till year 2010	Tuy Agency
Operation and maintenance of facility	Field inspection	-Sewerage treatment plant -Project-related communities	Every 6 months	No limit defined	Tuy Agency

Table J.2.7 Environmental Monitoring Plan for the Construction of Sand Settling Pond at Water Intake

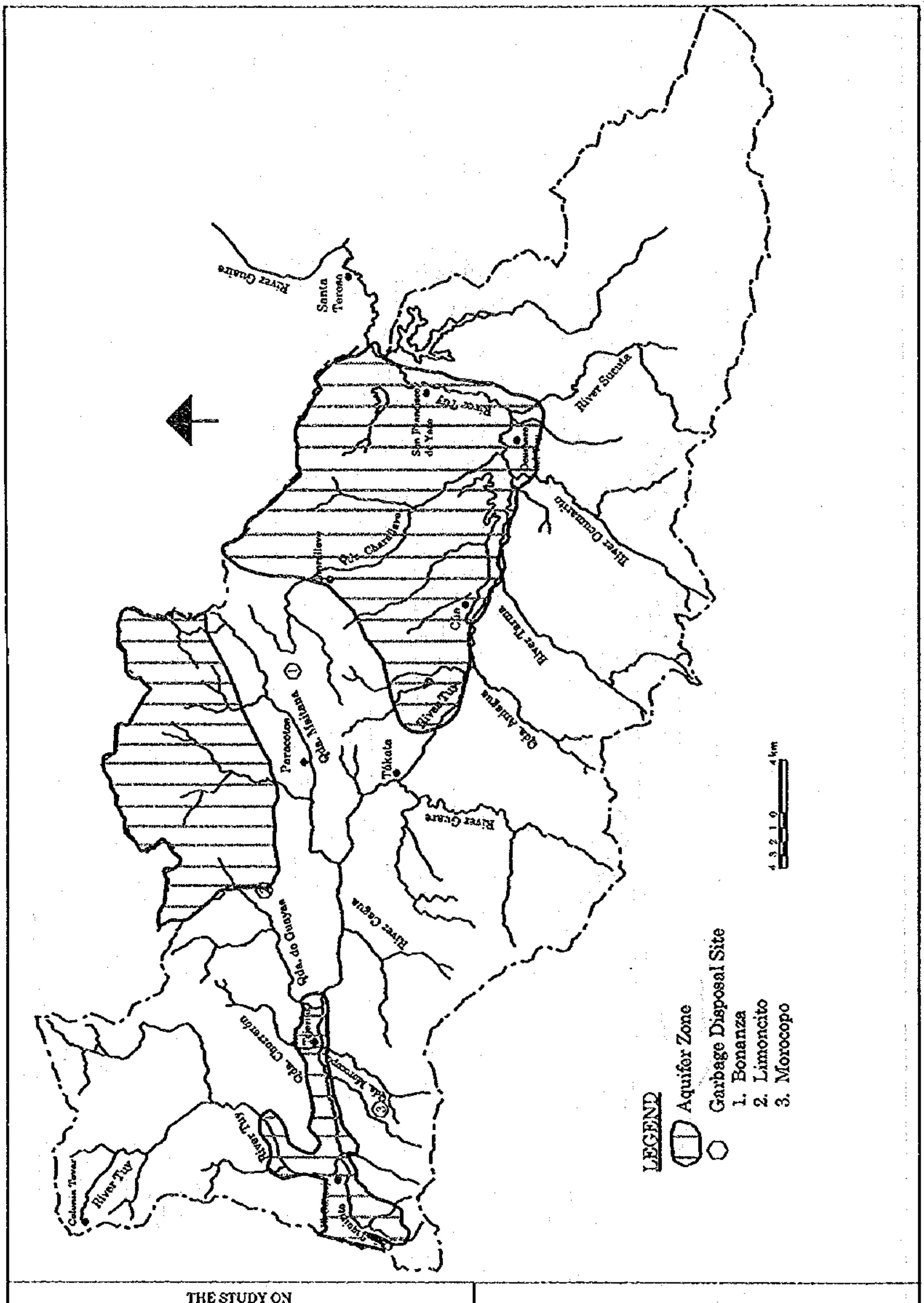
Monitoring Item	Monitoring Method	Location	Monitoring Frequency	Duration	Monitoring Agency
Illegal land use of project site	Field visit and inspection	Construction site and its surrounding areas	Every 6 months	No limit defined	-MARNR -Hidrocapital -Local Government
Noise	Measured by noise level meter	Communities close to project site	Once a month	Construction period	Tuy Agency
Dust and traffic congestion	Field inspection and measurement	-Construction site -Artery road to urban center	Once a month	Construction period	Tuy Agency
Sediment	Field inspection and measurement	Sampling points as selected in EIA	Every 6 months	Till year 2010	Tuy Agency
Aquatic biology	-Field inspection -Sample analysis	Sampling points as selected in EIA	Every 6 months	Till year 2010	Tuy Agency
Water quality of the Tuy River	Test and analysis of sample waters in laboratory	Sampling points as selected in EIA	Every 6 months	Till year 2010	Tuy Agency
Flushed sediment	-Field inspection -Volume of flushed sediment	-Sand settling pond -Downstream of intake weir	Once a month	Till year 2010	-Hidrocapital -Tuy Agency
Turbidity	Sample analysis in laboratory	Pre-treatment plant	Once a week	No limit defined	Hidrocapital
Water supply operation	-Pump operation hours -Volume of flushed sediment	Pre-treatment plant	Every 3 months	Till year 2010	Hidrocapital
Operation and maintenance of facility	Field inspection	Sand settling pond	Every 3 months	No limit defined	Hidrocapital

SECTOR J

FIGURES



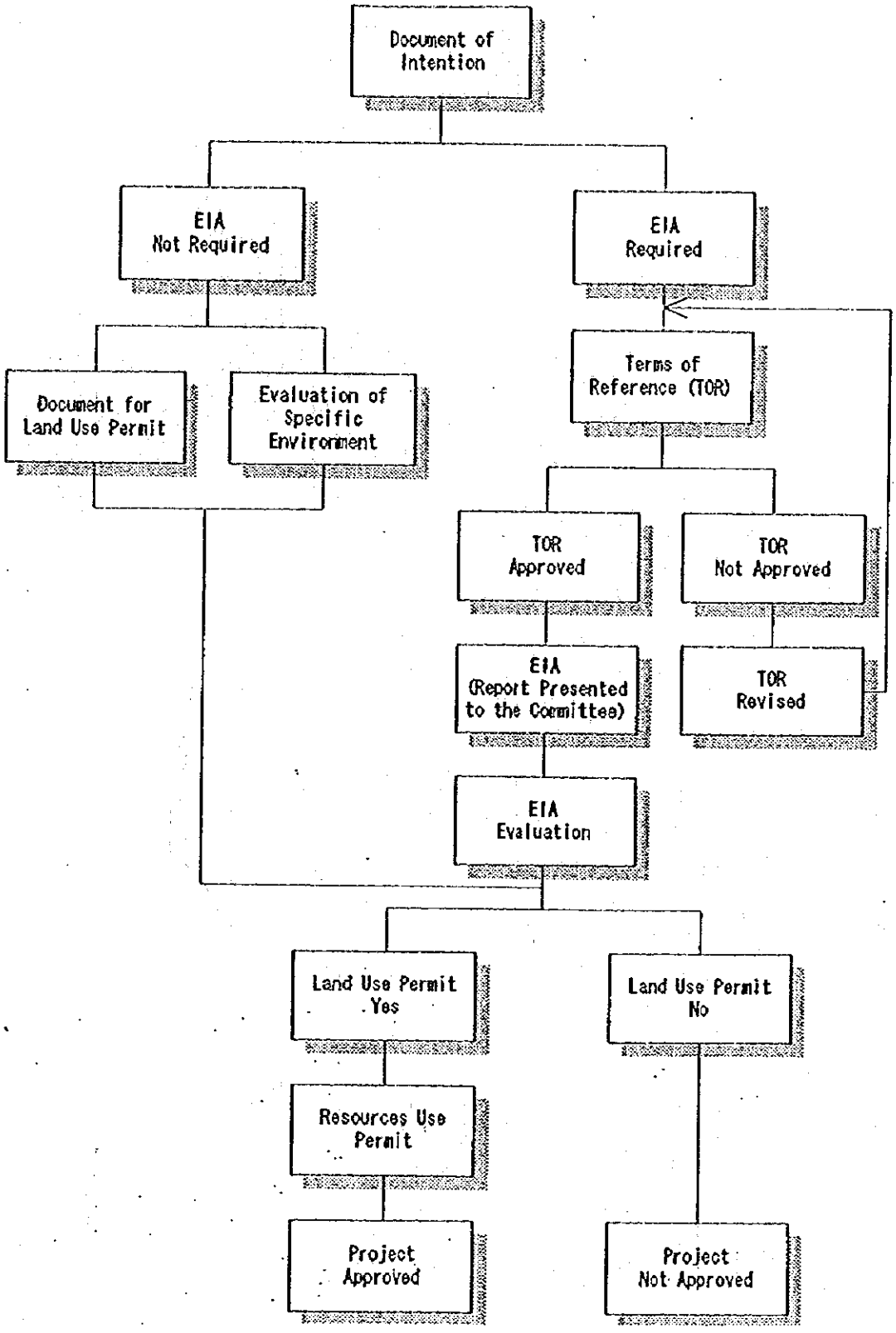
THE STUDY ON THE ENVIRONMENTAL IMPROVEMENT PROGRAM OF THE UPPER AND MIDDLE STREAM OF THE TUY RIVER BASIN IN THE REPUBLIC OF VENEZUELA	Fig. J.1-1 Areas under Special Administrative Regime
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON
THE ENVIRONMENTAL IMPROVEMENT PROGRAM OF THE UPPER AND MIDDLE
STREAM OF THE TUY RIVER BASIN
IN THE REPUBLIC OF VENEZUELA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. J.1-2 Location of Garbage Disposal Site and Aquifer Zone



THE STUDY ON
THE ENVIRONMENTAL IMPROVEMENT PROGRAM OF THE UPPER AND MIDDLE STREAM OF THE TUY RIVER BASIN
IN THE REPUBLIC OF VENEZUELA

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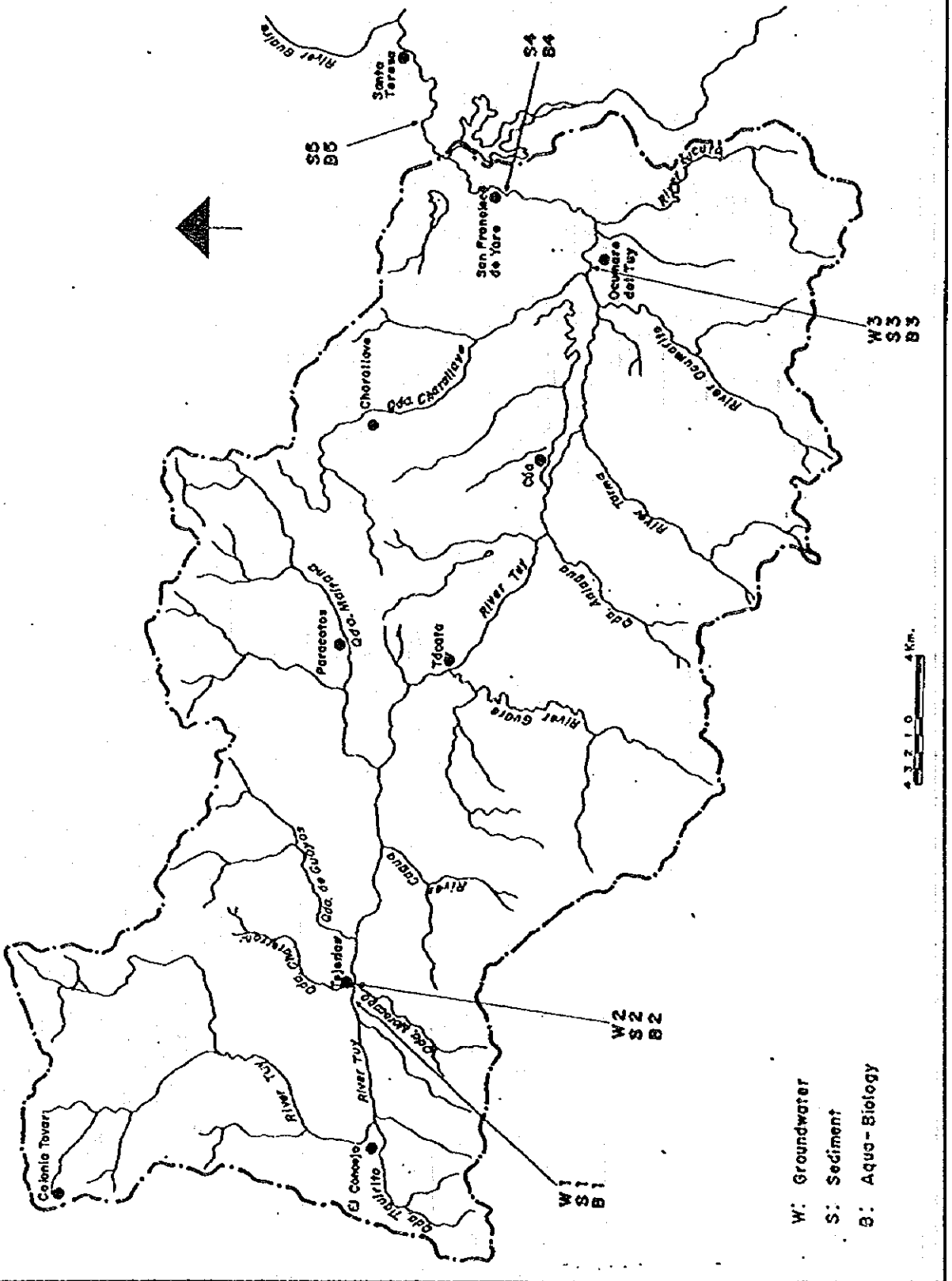
Fig. J.1-3 Procedure of EIA



THE STUDY ON THE ENVIRONMENTAL IMPROVEMENT PROGRAM OF THE UPPER AND MIDDLE STREAM OF THE TUY RIVER BASIN IN THE REPUBLIC OF VENEZUELA	Fig. J.1-4 Monitoring Sites
JAPAN INTERNATIONAL COOPERATION AGENCY