Chapter 23

PERMEABLE ROAD PAVEMENT PROJECT

23. PERMEABLE ROAD PAVEMENT PROJECT

23.1 Planning Condition

23.1.1 Selection of Project Sites suitable for Permeable Pavement

Most of the residential areas to require permeable pavement are located in a small serrate shaped peninsula which is stepwise sticking toward Billings Lake, and they are formed in small scale.

However, above residential areas constituting small-scaled lot sizes have been sold seriously against the legal requirement such as 1) Federal Decree-law on Division of Urban Land and Other Providences (Law No. 6,766-12/19/1979), 2) its revision (Law No.9,785-01/29/1999), 3) State Law on land use for protection of watershed, water course and water reservoir and other water resources in the Metropolitan Region of Big Sao Paulo (Law n^{o} 898 -11/01/1975) and 4) its supplementary law (Law n^{o} 1,172-17/11/1976).

The houses which were built on above illegal residential lots are obviously put into the “illegal housing”, where no areas for front and side space were secured and the boundaries between housing lot and road area were in an unbound state. These residential lots constitute their urban landscape in disorder and chaotic situation.

Above illegal residential lots are called as irregular (subnormal) residential areas and are classified as the following three types.

1) Irregular Subdivided Residential Lot（Loteamento Irregular）

This is the residential lots which housing developers have sold without any permission for authorized land-use or any development of basic infrastructures prior to their licensing procedures, while they applied for obtaining the selling permission of lot subdivision from the relevant authorities. The purchaser of above residential lots has built his house without any permission, and ept his residence there up to the present date.

2) Subdivided Residential Lot without Notice（Loteamento Clandestino）

This is the residential lot which housing developers or land owners subdivided the agricultural or forest lands and sold as residential areas without any notice. The purchaser of the residential lots has built his house and kept his residence there.

3) Squatter Housing Areas (so-called Favela)

The is the areas where the squatters have built their housing (so-called barracks) and taken

over after braking into the surrounding areas of above illegal residential areas, river sides of small rivers, swamp areas of Billings lakeside and steep slope areas with high risks of collapse danger.

The JICA Study team conducted a survey relating to the progress on urban upgrading process for land regularization and restructuring1) of the residential areas based on the current legal and social situation for the project sites together with the staffs from the department of planning and information technology (Secretaria de Planejamento e Tecnologia da Informacao) and SHAMA of SBC city. Table 23.1.1 shows the results of above survey indicating 19 candidate sites at the proposed residential areas. Cocaia district of its 19th candidate site was excluded from the aspect of the sewage development framework isolated communities and 18 candidate residential areas were adopted as project sites finally. Above 18 candidate sites do not include any squatter housing areas (so-called Favela) as mentioned in above 3) in accordance with the S/W of the JICA Study.

The classification of 3 construction work lots on the proposed project sites were decided by taking the estimated commencement time of above urban upgrading process1) at the residential areas and necessary construction period (commencement date of basic survey, required duration, duration for preparation of basic design and necessary period for obtaining approval permission from relevant authorities, etc.) into consideration.

Above 18 residential areas are shown in the Attachment drawings as “Suitable residential areas for road permeable pavement by construction work lot” and their current situation is shown in as the following photos.

Villa dos Quimicos:
Considerable time is estimated for urban upgrading process

Núcleo Santa Cruz:
Sewage leakage and power users are partially identified.

Jardim Serro Azul:
Steep road is identified.

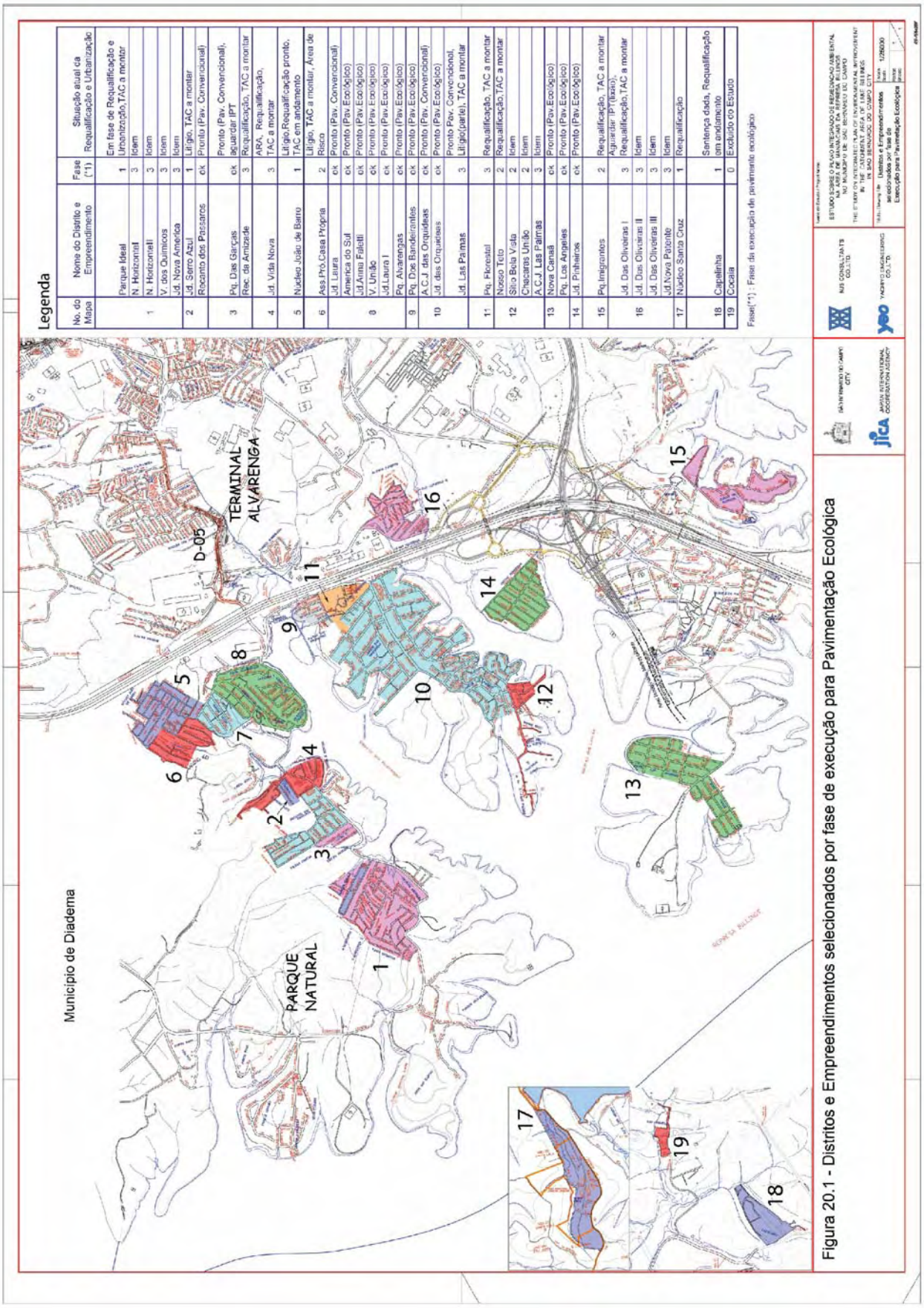
Núcleo João de Barro:
Road with relatively low gradient is identified.

Jardim Nova Patente:
Sewage leakage is identified.

Parque Imigrantes:
Comparatively good road condition is identified.

Photo 23.1.1 Residential areas for permeable pavement

Notes: Above photos show the current situation on residential streets to represent most of the proposed project sites, and they also show the importance on the urban upgrading process of each residential area as mentioned before.



No. do Mapa	Nome do Distrito e Empreendimento	Fase (*1)	Situação atual da Requalificação e Urbanização
1	Parque Ideal	1	Em fase de Requalificação e Urbanização,TAC a montar
	N. Horizonte II	3	Idem
	N. Horizonte I	3	Idem
	V. dos Químicos	3	Idem
	Jd. Nova América	3	Idem
2	Jd. Serro Azul	1	Litígio, TAC a montar
	Recanto dos Passaros	ok	Pronto (Pav. Convencional)
3	Pq. Das Garças	ok	Pronto (Pav. Convencional), aguardar IPT
	Rec. da Amizade	3	Requalificação, TAC a montar
4	Jd. Vida Nova	3	ARA, Requalificação, TAC a montar
5	Nucleo João de Barro	1	Litígio,Requalificação pronto, TAC em andamento
6	Ass.Pro.Casa Propria	2	Litígio, TAC a montar, Área de Risco
8	Jd. Laura	ok	Pronto (Pav. Convencional)
	America do Sul	ok	Pronto (Pav.Ecológico)
	Jd.Anna Faletti	ok	Pronto (Pav.Ecológico)
	V. União	ok	Pronto (Pav.Ecológico)
	Jd.Laura I	ok	Pronto (Pav.Ecológico)
9	Pq. Alvarengas	ok	Pronto (Pav.Ecológico)
	Pq. Dos Bandeirantes	ok	Pronto (Pav.Ecológico)
10	A.C.J das Orquideas	ok	Pronto (Pav. Convencional)
	Jd das Orquideas	ok	Pronto (Pav.Ecológico)
	Jd. Las Palmas	3	Pronto Pav. Convencional, Litígio(parte), TAC a montar
11	Pq. Florestal	3	Requalificação, TAC a montar
12	Nosso Teto	2	Requalificação,TAC a montar
	Sitio Bela Vista	2	Idem
	Chacaras União	2	Idem
	A.C.J Las Palmas	3	Idem
13	Nova Canaã	ok	Pronto (Pav.Ecológico)
	Pq. Los Angeles	ok	Pronto (Pav.Ecológico)
14	Jd. Pinheiros	ok	Pronto (Pav.Ecológico)
15	Pq.Imigrantes	2	Requalificação, TAC a montar Aguardar IPT(bazo).
16	Jd. Das Oliveiras I	3	Requalificação,TAC a montar
	Jd. Das Oliveiras II	3	Idem
	Jd. Das Oliveiras III	3	Idem
	Jd.Nova Patente	3	Idem
17	Nucleo Santa Cruz	1	Requalificação
18	Capelinha	1	Sentença dada, Requalificação em andamento
19	Cocaia	0	Excluído do Estudo

Figure 23.1.1 Suitable residential areas for road permeable pavement by construction work lot

Table 23.1.1 Residential Areas suitable for Permeable Pavement Road by Work Lot

No. of Residential Area	Allotment No.	Name of Residential Areas	Work Lot No.	Current Process of Legitimization at Residential Area
B-1	1	Parque Ideal	1	Urban upgrading process of residential area: Ongoing, TAC: To be prepared for agreement
B-2	1	Novo Horizonte I	3	- Ditto -
B-3	1	Novo Horizonte II	3	- Ditto -
B-4	1	Villa dos Quimicos	3	- Ditto -
B-5	1	Jardim Nova America	3	- Ditto -
B-6	2	Jardim Serro Azul	1	Under legal dispute, TAC: To be prepared
B-7	3	Recanto dos Passaros	OK	Road already paved (Traditional method)
B-8	3	Parque Das Garças	OK	Road already paved (Traditional method), waiting for the results of the risk analysis for steep slopes (IPT)
B-9	3	Recanto da Amizade	3	Urban upgrading process: To be prepared, TAC: To be prepared for agreement
B-10	3	Jardim Vida Nova		Located in ARA (Area for Environmental Remediation), of residential area: To be prepared, TAC: To be prepared for agreement
B-11	5	Núcleo João de Barro	1	Under legal dispute, Urban upgrading process: Completed , TAC: On-going for agreement
B-12	6	Assoc. Pró Casa Próría	3	Includes dangerous area (AR), Legitimization and reconstructuring process: To be prepared, TAC: To be prepared for agreement
B-13	7	Jardim Laura	OK	Road already paved (Traditional method)
B-14	8	America do Sul	OK	Road already paved (Permeable Pavement method)
B-15	8	Jardim Anna Faletti	OK	Road already paved (Permeable Pavement method)
B-16	8	Villa União	OK	Road already paved (Permeable Pavement method)
B-17	8	Jardim Laura I	OK	Road already paved (Permeable Pavement method)
B-18	8	Parque Alvalengas	OK	Road already paved (Permeable Pavement method)
A-1	9	Parque Dos Bandeirantes	OK	Road already paved (Permeable Pavement method)
A-2	10	Parque Florestal	OK	Road already paved (Traditional method)
A-3	10	A.C.J. das Orquideas	OK	Road already paved (Permeable Pavement method)
A-4	10	Jardim das Orquideas	OK	Road already paved (Traditional method), Partly under legal dispute
A-5	11	Jardim Las Palmas	3	Urban upgrading process: To be prepared, TAC: To be prepared for agreement
A-6	12	Nosso Teto	2	Includes the area of Permanent Protection Area (APP), Urban upgrading process: To be prepared, TAC: To be prepared for agreement
A-7	12	Sitio Bela Vista	2	- Ditto -
A-8	12	Chacaras União	2	- Ditto -
A-9	12	A.C.J. Las Palmas	2	- Ditto -
D-1	13	Nova Canaã	OK	Road already paved (Permeable Pavement method)
D-2	13	Parque Los Angeles	OK	Road already paved (Permeable Pavement method)
E	14	Jardim Pinheiros	OK	Road already paved (Permeable Pavement method)
F	15	Parque Imigrantes	2	Including Permanent Protection Area (APP), Urban upgrading process: To be prepared, TAC: To be prepared for agreement
P.S-1	16	Jardim Das Oliveiras I	3	Urban upgrading process: To be prepared, TAC: To be prepared for agreement
P.S-1	16	Jardim Das Oliveiras II	3	Urban upgrading process: To be prepared, TAC: To be prepared for agreement, waiting for the results of IPT's risk

				analysis (Industrial waste)
P.S-1	16	Jardim Das Oliveiras Ⅲ	3	Urban upgrading process: To be prepared, TAC: To be prepared for agreement, waiting for the results of IPT's risk analysis (Industrial waste)
P.S-1	16	Jardim Nova Patente	3	Urban upgrading process: To be prepared, TAC: To be prepared for agreement, waiting for the results of IPT's risk analysis (Industrial waste)
N-1	17	Núcleo Santa Crus	1	Urban upgrading process: To be prepared
N-2	18	Capelinha	1	Urban upgrading process: On-going
N-3	19	Cocaia	-	To be excluded from the study

Notes)
Refer to Chapter 18 regarding of residential Area No. , 2) Refer to Index (Indece) of Attachment Drawings 23.1 regarding to Allotment No., 3) IPT-Institute of Research & Technology (Instituto de Pesquisa e Tecnologia)

23.1.2 Road Alignment Plan

Since as mentioned in **23.1.1** all the proposed streets are facing the illegal residential lots and housings, the boundaries between the proposed streets and already built-up housings are in unbound state and its road alignment plan accompanying the increase of road width seems to be unfeasible, the road alignment plan was conducted as the following manners;

1) To change the alignment shape of the pavement parts including side ditch,

2) And to face-up the alignment of the housing lot in walkway side to those of the current roads

23.1.3 Road Longitudinal Plan

Since most of the housings are facing the proposed streets, the road longitudinal plan causing the large-scaled open cutting or embankment works will be unfeasible for the construction even in steep slopes. This means that the introduction of the easement curve should be minimized at the slope changing and intersection points.

Height adjustment of neighboring lots at the steep sidewalk will be difficult for its planning and design from the following reasons;

1) The width of most of the housing lots is below the minimum standard (5.00 m) and the worst case is 3.5m approximately,
2) The land use of all the proposed sites is not classified as restricted residential district, and their parallel use to the household industry or commerce such as sheet metal working, coating / painting and barbers is identified,
3) And the entrance space of parking occupies most of the walkway space because of their own parking areas since most of the residents their own cars in spite of the low income.

It will be necessary to conduct the walk way design at execute design stage taking the road gradient and width into careful consideration, while keeping the appropriate walkway environment

increasing its permeability seems to be difficult especially in narrow walkway. **Table 23.1.2** shows the height adjustment of neighboring lots with their parking areas.

Table 23.1.2 Height Adjustment of Neighboring Lots (m)

(In case of 2.0m entrance width of parking area)

No.	Gradient of front roadway (%)	Width of housing lot	Adjusted height between neighboring lots	Adjusted height except parking entrance	No.	Gradient of front roadway (%)	Width of housing lot	Adjusted height between neighboring lots	Adjusted height except parking entrance
1	10.00	5.00	0.50	0.30	3	20.00	5.00	1.00	0.80
		4.50	0.45	0.25			4.50	0.90	0.70
		4.00	0.40	0.20			4.00	0.80	0.60
2	15.00	5.00	0.75	0.55		25.00	5.00	1.25	1.05
		4.50	0.68	0.48			4.50	1.13	0.93
		4.00	0.60	0.40			4.00	1.00	0.80

23.1.4 Road Cross-sectional Design

SBC city announced officially the municipal decree-law of No. 4,803 dated November 4th 1999 in accordance with the federal law and its revision as mentioned in **23.1.1** and regulated the formation of "special sector in special urbanization (Setores Especiais de Urbanização Específica)". SBC established the standard road width as shown in **Table 23.1.3** in above municipal decree-law, where the urban upgrading of the subnormal residential areas (Assentamentos subnormais) and the special sector (SE3) aiming at sound development is regulated.

Table 23.1.3 Three Types of Standard Road Width applied in Special Sector District in SBC

No.	Road Type	Total Width (m)	Width of roadway (m)	Remarks
1	Trunk road in District	12.00	8.00	Main road for the district traffic
2	Street	10.00	7.00	Streets connecting with each housing lots and district parking areas
3	Emergency pathway	6.00	4.00	Exclusive roads for the emergency access for ambulance and fire-fighting vehicles

Notes)

Above regulation is specified in the third subject, chapter II, clause V, sub-clauses of IV of Municipality Decree-law No. 4,803 and articles of 34.

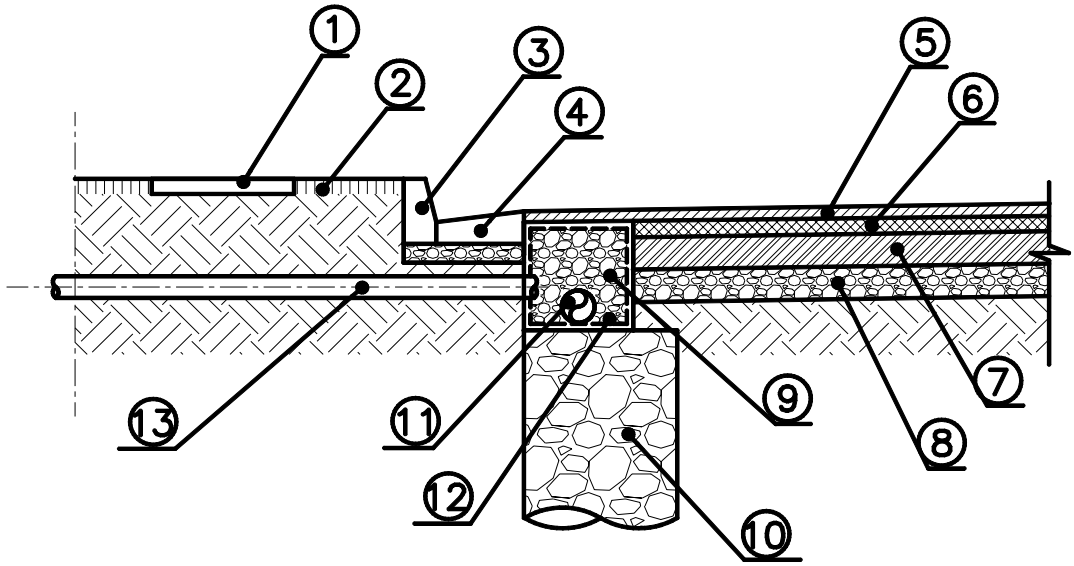
However, according to the site survey of the proposed residential lots at No.1 construction work lot and the several parts at No.2 and No.3 work lots and the measuring of the current road width, where houses are standing at both sides of the streets and the topographical steep slopes are originally

located, it turned out that the "small streets" with narrow road width should be regulated other than SBC's standard streets from the fact that many streets could not secure the total road width of 10 m.

23.2 Outlined Facility Design

23.2.1 Standard Design of Permeable Pavement Road

Figure 23.2.1 shows the standard drawing for the proposed construction method, which was decided by referring to the information from "Handbook on Permeable Pavement" written by Japan Road Construction Association in addition to the local method on permeable pavement method which has been mainly promoted by SHAMA of SBC city.



No.	Material and Dimensions, etc	No.	Material and Dimensions, etc
①	Walkway concrete (Uniform finishing), t=7cm	⑧	Lower subbase: Mixed gravel (t=15cm)
②	Walkway turf (Esmeralda species)	⑨	Pervious trench: No.3 Gravel (50cm x 50cm)
③	PC edge stone（Municipality type, H=30cm）	⑩	Pervious well: No.3 Gravel + Broken stone (Ø=70cm)
④	Side ditch (cast in-situ concrete, t=10cm-15cm）	⑪	Perforated drain pipe: PVC Ø=15cm
⑤	Surface layer: Pervious asphalt (CPA: t=5cm)	⑫	Liner sheet (Bidim)
⑥	Base layer: Normal asphalt (PMQ: t=7cm)	⑬	Rainwater drain pipe inside housing lot: PVC Ø=10cm
⑦	Upper subbase: Size controlled gravel (t=15cm)		

Figure 23.2.1 Standard Construction Method of Permeable Pavement Road

Notes)
1. As waterproof and adhesive material the coating by using asphalt emulsion is made on the compacted upper subbase ( ) and base layer of normal asphalt ( ) in the same manners of the traditional asphalt pavement.
2. The permeable well ( ) is 6.5 m deep and allocated every 30 m interval in both sides of the road in case of both side gradients, and every 30 m in downstream direction in one-side gradient in case of one-way road or emergency road with their narrow road width.

23.2.2 Road Width Design

The standard road width design can be conducted as shown in **Table 23.2.1** based on the survey on the current situation of residential streets and by referring to the standard width as mentioned in the standard road width of "special sector in special urbanization (Setores Especiais de Urbanização Específica)" as already explained in **23.1.4**.

Table 23.2.1 Standard Road Type

No.	Type No.	Road Classification	Width of Walkway (m)	Width of Side Ditch (m)	Width of Pavement (m)	Width of Side Ditch (m)	Width of Walkway (m)	Total Width (m)	Remarks
1	T-1	Trunk road in District	1.50	0.60	6,80	0.60	1.50	11.0	Lower subbase: 40cm
2	T-2	- Ditto -	1.50	0.60	6,80	0.60	1.50	11.0	Lower subbase: 10cm
3	R-A1	Street	1.50	0.60	5.80	0.60	1.50	10.0	Lower subbase: 40cm
4	R-A2	- Ditto -	1.50	0.60	5.80	0.60	1.50	10.0	Lower subbase: 10cm
5	R-A3	- Ditto -	1.50	0.60	5.80	0.60	1.50	10.0	No Lower subbase:
6	R-B1	Small Street	1.00	0.60	4.80	0.60	1.00	8.00	Lower subbase: 40cm
7	R-B2	- Ditto -	1.00	0.60	4.80	0.60	1.00	8.00	No Lower subbase:
8	R-C1	Emergency roads	0.75	0,60	3.60	0.60	0.75	6.30	Lower subbase: 40cm
9	R-C2	- Ditto -	0.75	0,60	3.60	0.60	0.75	6.30	No Lower subbase:
10	V-1	Passageway						4.00	

Notes)
The walkway width should be increased in case that the road width of existing dirt road is over the total road width.

23.2.3 Stormwater Drainage Facility

As already explained in **23.1.3**, the design of stromwater drainage facility shall be conducted by installing drain hole (Baca de Lobo), drain box and rainwater manhole because of the possible occurrence of partial flood to be caused by spill water at intense rainfall for the following cases;

1) In case that the district trunk road runs its lowland from the difficulty on the improvement of the longitudinal road gradient,
2) In case of the ground pocket at the steep streets and small streets

23.3 Construction Plan

23.3.1 Ground Condition

The results for geological survey in and around the project sites for the sewage treatment projects is used as reference since such geological survey was not conducted at the proposed project sites.

Table 23.3.1 Soil Condition at Proposed of Pump Stations Sites in Courous Sewer Pipes

Geology	Soil Condition	Groundwater and Permeability
Sedimentary soil, quaternary deposit and lower weathered base rock constitute the site geology; <Sedimentary Soil> Sandy silt is a major component. Layer thickness is 4.8m, 1.0m and 2.0m in CA-1, CA-2 and CA-3, respectively. <Quaternary Deposit> Layer thickness is 3.5m to 6.0m. Clay and silt are stratified in the upper to middle layers: sand and gravel mixed sand in lower layer. <Lower Weathered Base Rock> The severely weathered base rock layer of schist, granite and gneiss is identified from 9.0m depth from the ground level in CA, 6.7m in CA-2 and 5.6m in CA-3, respectively. The upper layer varies to soft clay, silt and the middle-lower layer varies to sandy silt to silty sand.	<Sedimentary Soil> N value: 3 to 4, 3 partly <Quaternary Deposit> N value: 0 to 2 in clay and silt, 1 to 9 in sandy layer, 21 in partially sand mixed layer and its maximum layer of 2m. <Severely Weathered Base Rock> 3 to 4 m depth from the upper boundary with the base rock: Soft soil with N value of 2 to 4. 5m depth from the boundary: N value over 10 5 to 10 m depth from the boundary: N value over 15 6 to 14 m depth from the boundary: N value over 30.	<Water table> The water table of the groundwater is almost same as the neighboring river water table. <Permeability> k= 3.35 x 10^{-5} cm/sec in severely weathered layer of schist of CA-3 Estimated permeability of k= 1.21 x 10^{-3} cm/sec in the sand and gravel mixed sand of the quaternary deposit from the sample of CB-4.

Notes)

1) The proposed permeable well shall penetrate the sedimentary soil and the quarterly deposit to reach the base rock (severely weathered layer). The depth of the proposed well shall be set as 6.5m by considering the estimated total average layer thickness of 6.25m of CA-1 and CA-2 layers neighboring the proposed project site.
2) The enough consideration for the moisture control at the compaction process of road bed shall be taken since most of the construction works of subbase will be carried out at the sandy silt layer. The improvement of the subbase by of approximately t=40 cm depth shall be required because some submergence is anticipated for the surrounding housing lots and road edges to the upper and lower road subbase at the ground pocket in the longitudinal direction.

23.3.2 Construction Plan

The construction shall be conducted by dividing 3 construction work lots as explained in **23.1.1** by considering the commencement of "urban upgrading process of the residential areas (Empreendimento e/ou Núcleo)", basic study and estimated period for the basic design. **Table 23.3.2** shows the construction plan by work and residential lot.

Table 23.3.2 Construction Work Plan by Work Lot and Residential Area

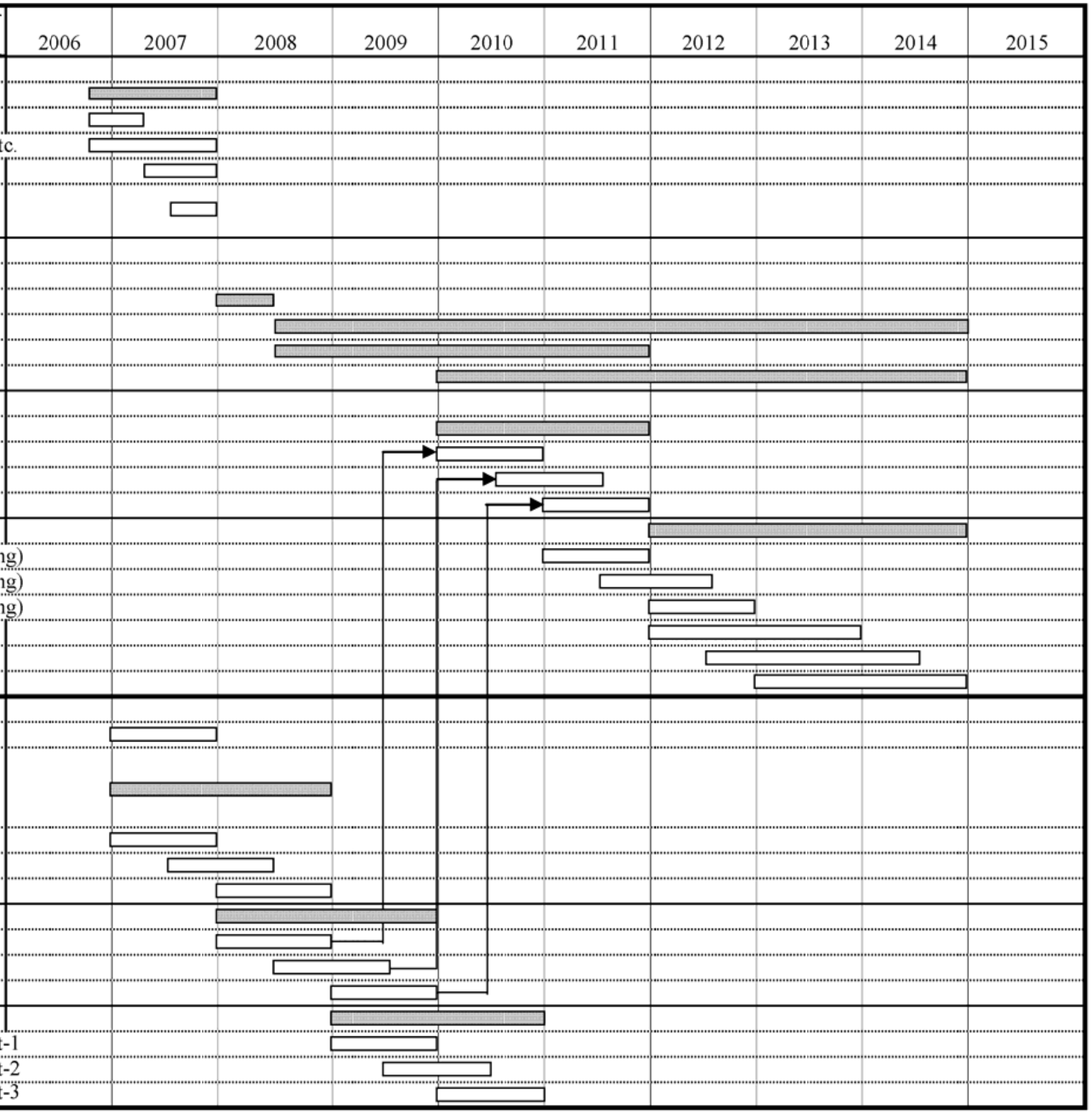
Lot No.	Name of Residential Lot	Pavement Facility		Storm water Drain Facility			
		Road Type	Road Extension (m)	Number of Drain Holes & Drain Box	Number of Manhole	Length of Drain Pipe (m)	Number of Drain Pipe at Housing Lot
No.1 Work Lot							
B-1	Parque Ideal	T-1	500.00	8	4	510.00	484
		R-A1	1,090.00	6	2	42.00	222
	Sub Total		1,590.00	14	6	552.0	706
B-3	Nucleo Joao de Barro	T-1	90.00	4	1	100.00	136
		T-2	384.00	22	6	319.00	338
		R-A1	60.00	2	1	30.00	27
		R-A3	2,967.00	4	0	20.00	2,543
		R-C2	304.00	3	0	15.00	42
	Sub Total		3,805.00	35	8	484.00	3,086
B-6	Jardim Serro Azul	T-2	152.00	0	0	0	210
		R-B2	472.00	2	0	12.00	68
	Sub Total		624.00	2	0	12.00	278
N-1	Nucleo Santa Cruz	T-1	400.00	8	0	42.00	54
		T-2	1,370.00	8	0	74.00	232
		R-A2	690.00	3	1	77.00	276
		R-A3	895.00	5	4	77.00	358
		R-B1	625.00	7	3	364.00	250
		R-C2	275.00	3	0	46.00	37
	Sub Total		4,325.00	36	8	813.00	1,207
N-2	Capelinha	R-B2	2,060.00	14	0	173.00	916
		V-1	325.00	0	0	0.00	0
	Sub Total		2,385.00	14	0	173	916
	Sub Total of No.1 Work Lot		12,729.00	101	22	2,034.00	6,250
No.2 Work Lot							
A-6	Nosso Teto	T-2	288.00	0	0	0.00	0
		R-B2	166.00	2	0	5.00	74
	Sub Total		454.00	2	0	5.00	74
A-7	Sitio Bela Vista	R-B2	78.00	0	0	0	35
A-8	Chacaras Uniao	R-A2	386.00	2	0	5.00	0
		R-B2	78.00	2	0	5.00	0
	Sub Total		464.00	4	0	10.00	0
A-9	A.C.J. Las Palmas	R-B2	238.00	1	0	5.00	25
B-12	Ass. Pro Casa Propria	R-B2	2,050.00	10	0	5.00	911
F	Parque Imigrantes	R-A1	350.00	8	0	48.00	44
		R-A3	1,935.00	2	1	68.00	388
		R-B1	150.00	6	0	30.00	30
		R-B2	600.00	0	0	0	150
	Sub Total		3,035.00	16	1	146.00	758
	Sub Total of No.2 Work Lot		6,329.00	33	1	171.00	1,657
No.3 Work Lot							
A-2	Parque Florestal	R-A3	750.00	6	0	36.00	300
B-2	Novo Horizente I, II	R-A3	1,231.00	6	1	40.00	750
		R-B2	1,550.00	14	0	70.00	690
	Sub Total		2,781.00	20	1	110.00	1,440
B-4	Villa dos Quimicos	R-A3	777.00	6	0	30.00	345
		R-B2	863.00	6	0	30.00	385
		V-1	194.00	0	0	0.00	0
	Sub Total		1,834.00	6	0	60.00	730
B-5	Jardim Nova America	R-A3	541.00	4	0	10.00	145
B-9	Recanto da Amizade	R-A1	50.00	0	0	0.00	11
		R-A3	200.00	2	0	5.00	90
	Sub Total		250.00	2	0	5.00	101
B-10	Jardim Vida Nova	R-A3	728.00	8	0	48.00	320
PS-1	Jardim Das Oliveriras I, II, III	R-A1	55.00	2	0	5.00	12
		R-A3	2,071.00	14	0	70.00	920
	Sub Total		2,126.00	16	0	75.00	932
	Jardim Nova Patente	R-B2	1,197.00	0	0	0	532
	Sub Total of No.3 Work Lot		10,207.00	68	1	344.00	4,500
	Grand Total		29,265.00	202	24	2,549.00	12,407

23.3.3 Implementation Schedule

The implementation schedule of the proposed project shall be prepared by taking the collaboration works of SBC city and SABESP for the sewage treatment projects into consideration. The implementation schedule of the proposed project considering above schedule of the sewerage treatment project is shown in **Table 23.3.3**.

Table 23.3.3 Implementation Schedule of the Permeable Pavement

No.	Item
A	Preparation for Projects under JBIC Loans
A-1	Works for Loans Obtention
A-1.1	Formulation of Consulting Letter
A-1.2	Works according to the Procedure of COFIEX & etc.
A-1.3	JBIC's Analysis
A-1.4	Exchange of Notes (E/N) & Signeture of Loan Agreement (L/A)
A-2	Execution of JBIC's Work Lot
A-2.1	Selection of Consultants
A-2.1.1	Competitive Bidding (P/Q & Bidding)
A-2.1.2	Management Works
A-2.1.3	Drawing up of Datail Design (D/D)
A-2.1.4	Supervision Works
A-3	Implementaion Schedule of Permeable Pavement
A-3.1	Drawing up of Datail Design (D/D)
A-3.1.1	D/D of Work Lote-1
A-3.1.2	D/D of Work Lote-2
A-3.1.3	D/D of Work Lote-3
A-3.2	Construction Schedule
A-3.2.1	Competitive Bidding of Work Lot-1 (P/Q & Bidding)
A-3.2.2	Competitive Bidding of Work Lot-2 (P/Q & Bidding)
A-3.2.3	Competitive Bidding of Work Lot-3 (P/Q & Bidding)
A-3.2.4	Constrution of Work Lot-1
A-3.2.5	Constrution of Work Lot-2
A-3.2.6	Constrution of Work Lot-3
B	Projects by SBC Municipality
B-1	Work for Obtention of Domestic Finance
B-2	Studies & Basic/Detail Planning for Re-qualification & Urbanization, and/or Formulation of TACs regarding to Subnormal Residential
B-2.1	Ditto to Work Lot-1
B-2.2	Ditto to Work Lot-2
B-2.3	Ditto to Work Lot-3
B-3	Drawing up of Datail Design (D/D)
B-3.1	D/D of Work Lote-1
B-3.2	D/D of Work Lote-2
B-3.3	D/D of Work Lote-3
B-4	Execution of SBC's Projects
B-4.1	Execution of SBC's Projects regarding to Work Lot-1
B-4.2	Execution of SBC's Projects regarding to Work Lot-2
B-4.3	Execution of SBC's Projects regarding to Work Lot-3



23.4 Operation & Maintenance Plan

23.4.1 Maintenance Work for Keeping Infiltration Capacity of Permeable Pavement

Periodical cleaning shall be necessary in order to keep the infiltration capacity of the surface layer because the intrusion of fine soil due to the vehicle traffic and the sediment from the green space and slope turf outside the road areas.

The current SBC's repairing and cleansing service (which is currently conducted by Urban Service Department: Secretaruia de Serviços Urbano/EU) with his using sanitation vehicles such as water cannon trucks (Caminhão Errigadeira) may have applicability to above maintenance works of the proposed project. 1 to 2 times of periodical cleansing works will be sufficient for the proposed case.

23.4.2 Maintenance Work for Keeping Capacity of Permeable Facilities (e.g. Pervious Trench)

The installation of the drain box will be impossible when the situation on the narrow space and high building coverage of the current housing lots, no expectation for the rainwater infiltration inside the housing lots and the project goal of area source pollutants reduction is taken into consideration. For the reasons, the design concept, which collects the rainwater at rainwater guttering and exterior parts into the individual rainwater box and carry out their following drop-in into the pervious trench, is adopted. However, the method will cause the possibility of the reduction of the permeability by accelerating clogging at the trench by the generation of sediments and sewage inside housing lots. This means that the research and development of the individual water collection box attached with the filters for removing above sediments and sewage at execute design is necessary, and that the installation works of above water collection box should be conducted at walkway or inside housing lots.

Above maintenance works of the individual facilities possibly can be implemented by the reinforcement of the backup of the public participation / corporation program of "Programa Bairro Ecológico" at the initiative of SHAMA who has already had experiences in 51 residential areas.

23.5 Cost Estimate

23.5.1 Construction Cost

The unit prices of each work item for the construction cost were set out based on the following information from (refer to attachment data **Table 23.5.1**);

The interview results with the technical staffs of SBC's transportation and public road department (Secretaria de Transporte e Vias Públicas) who conducts currently the Urban Transportation Program (Programa de Transporte Urbano de São Bernardo do Campo) financed by IDB

1) The interview results with the local contractors who have track records for permeable pavement roads

2) The interview results with the local consultants in Sao Paulo who are working mainly for road-related projects, and

3) The data on cost estimate in domestic projects in Brazil

Table 23.5.1 shows the cost estimate by work lot and residential area, and the detailed dimensions and components of actual streets and proposed streets at work lot No.1 are shown in **Table 23.5.2** of the attachment data.

Table 23.5.1 Cost Estimates of Construction by Work Lot and Residential Areas (R$)

No. of Residential Area	No. of Allotment	Name of Residential Area	Road Extention (m)	Cost of Permeable Pavement Facility (R$)	Cost of Stormwater Drain Facility (R$)	Total Cost (R$)	Unit Price of Road (R$/ml)
B-1	1	Parque Ideal	1,590.00	1,654,842.18	330,029.33	1,984,871.51	1,248.35
B-3	5	Núcleo João de Barro	3,805.00	3,062,959.43	440,517.00	3,503,476.43	920.76
B-6	2	Jd. Serro Azul	624.00	530,637.90	36,952.67	567,590.57	909.60
N-1	17	Núcleo Santa Cruz	4,325.00	3,921,364.30	524,854.00	4,446,218.30	1,028.03
N-2	18	Bairro Capelinha	2,385.00	1,626,427.37	183,035.11	1,809,462.48	758.68
		Total de Lote- 1	12,729.00	10,796,231.18	1,515,388.11	12,311,619.29	967.21
A-6	12	Nosso Teto	464.00	417,427.94	11,660.00	429,087.94	924.76
A-7	12	Sitio Bela Vista	78.00	54,705.30	3,850.00	58,555.30	750.71
A-8	12	Chacaras União	386.00	345,809.68	3,520.00	349,329.68	905.00
			78.00	54,705.30	3,520.00	58,225.30	746.48
A-9	12	Chacaras União	464.00	400,514.98	7,040.00	407,554.98	878.35
A-9	12	A.C.J. Las Palmas	238.00	166,921.30	5,555.00	172,476.30	724.69
B-12	6	Assoc. Pró Casa Própria	2,050.00	1,437,767.50	109,450.00	1,547,217.50	754.74
F	15	Pq.Imigrantes	3,035.00	2,440,653.00	141,383.00	2,582,036.00	850.75
		Total de Lote-2	6,329.00	4,917,990.02	278,938.00	5,196,928.02	821.13
A-2	11	Pq. Florestal	750.00	598,875.00	52,338.00	651,213.00	868.28
B-2	1	N. Horizonte Ⅰ, Ⅱ	2,781.00	2,070,046.00	220,275.00	2,290,321.00	823.56
B-4	1	V. dos Quimicos	1,834.00	1,240,525.03	113,960.00	1,354,485.03	738.54
B-5	1	Jd. Nova America	541.00	431,988.50	22,990.00	454,978.50	841.00
B-9	2	Recanto da Amizade	250.00	210,229.00	14,630.00	224,859.00	899.44
B-10	4	Jd. Vida Nova	728.00	581,308.00	60,984.00	642,292.00	882.27
PS-1	16	Jd. das Oliveiras Ⅰ, Ⅱ, Ⅲ	2,126.00	1,709,275.40	145,310.00	1,854,585.40	872.34
	16	Jd. Nova Patente	1,197.00	839,515.95	58,520.00	898,035.95	750.24
		Total de Lote-3	10,207.00	7,681,762.88	689,007.00	8,370,769.88	820.10
		Total de Empreendimento	29,265.00	23,395,984.08	2,483,333.11	25,879,317.19	884.31

23.5.2 Operation & Maintenance Cost

The operation and maintenance works of the proposed project shall be conducted by Urban Service Department (Secretaruia de Serviços Urbano/EU) as an operation and maintenance work for road networks.

Only the cleansing cost for the proposed project is shown in **Table 23.5.2**

Table 23.5.2 Cost Estimate of Operation and Maintenance/Cleansing Work by Water Cannon Trucks (R$)

No.	Item	Unit	Cost (R$)	Operation Cost (R$/day)	Notes
1	Water Cannon Truck (Depreciation: 6 years)	L.S.	180,000.00	125.00	Operating-day: 20day/month
2	Personnel Expenses (Driver & Operator)	Month	7,560.00	378.00	Working-day: 20day/month
3	Expenses of Fuel & Maintenance	Day	18.00	18.00	
	Total Cost per Working Day			521.00	
4	Total Cost of Cleansing Work for Proposed Project（205.000,00m2)	L.S.		1,980.00	Cleansing Width: 7,00m , Cleansing Capacity : 150m2/min., Working-hour: 6

Chapter 24

ALVARENGA PARK PLANNING

24 ALVARENGA PARK PLANNING

24.1 Design Policy

The park planning policy is to preserve green belt as much as possible and to introduce the rainfall infiltration facilities in new development areas. The Alvarenga Park will be formulated at flatland of along the Alvarenga River with constructing Alvarenga River trunk sewer in this project.

24.2 The concept design of facilities

The location and general design maps of Alvarenga Park are shown in **Figure 24.2.1** – **24.2.3**. This park can be arranged aside of Alvarenga River trunk sewer where the flatland has enough space to build a park. The area of the park is 21,121 square meter. This park precinct has to be defined by fences as safety measures for preventing invasions because the project area includes the maintenance road of the trunk sewer.

The lawn, landscape gardening and tree planting will contribute to reduce storm water runoff with consideration of park scenery. There are no facilities in the park to be constructed to available for multipurpose park. The left bank of the Alvarenga River will be available as a promenade after installing a green belt. There are no parking lots because of an access on foot only.

The maintenance roads of SABESP need 4 meters wide to make vacuum equipped truck pass though. The maintenance of trunk sewer shall be conducted irregularly by SABESP when flow obstacle happened to be inside pipe. Installing the Alvarenga Park is not accompanied by the constructions of trunk sewer and maintenance road because the Alvarenga Park will be built by Sao Bernard do Campo City. The river improvement with trunk sewer constructions is not included in this project.

24.3 Implementation Program

24.3.1 Construction Planning

Since the projected land is barren, preparatory and temporary works should be at minimum in construction processes without deforestation. The building materials shall be carried through the planned approach route. The simultaneous constructions for the Alvarenga Park and Alvarenga river trunk sewer should be taken into account for more efficiency of time and economy.

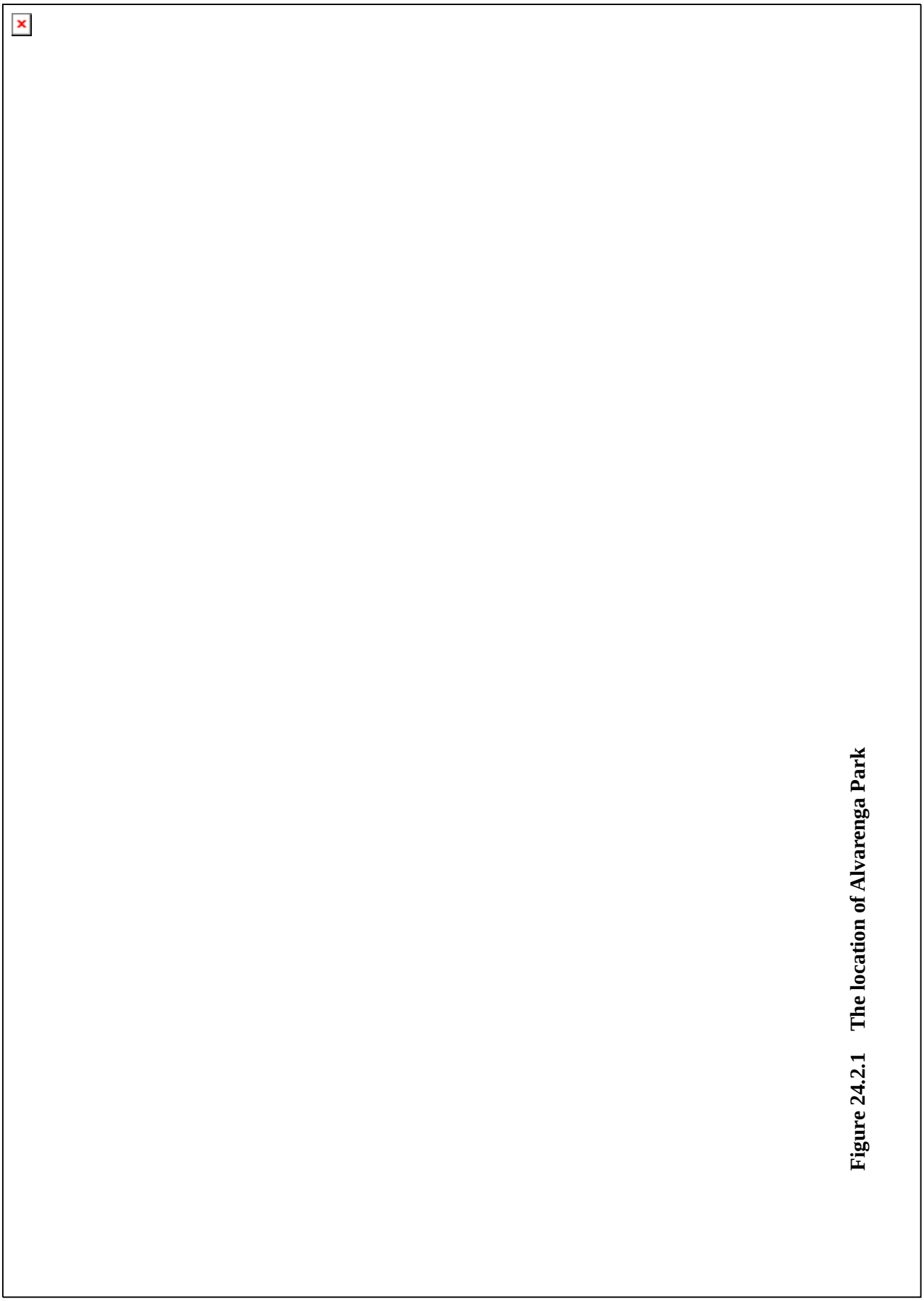


Figure 24.2.1 The location of Alvarenga Park

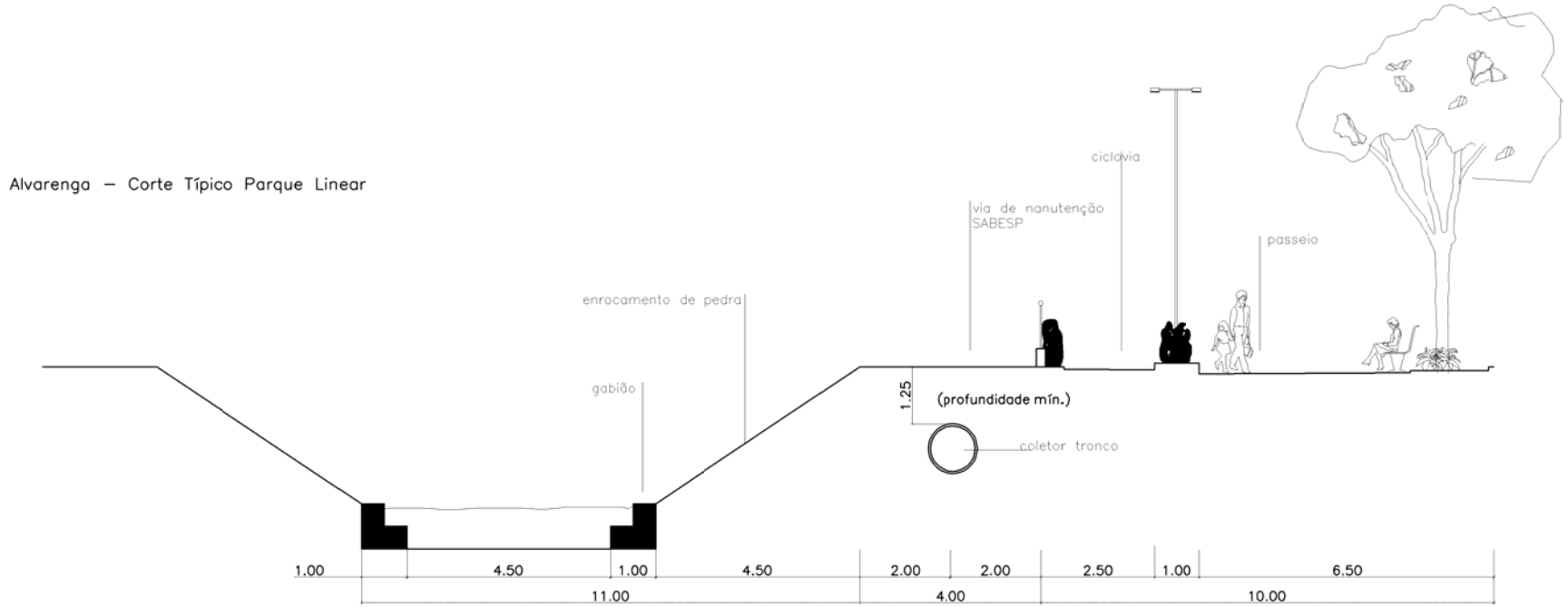


Figure 24.2.2 Sectioned drawing of Alvarenga Park

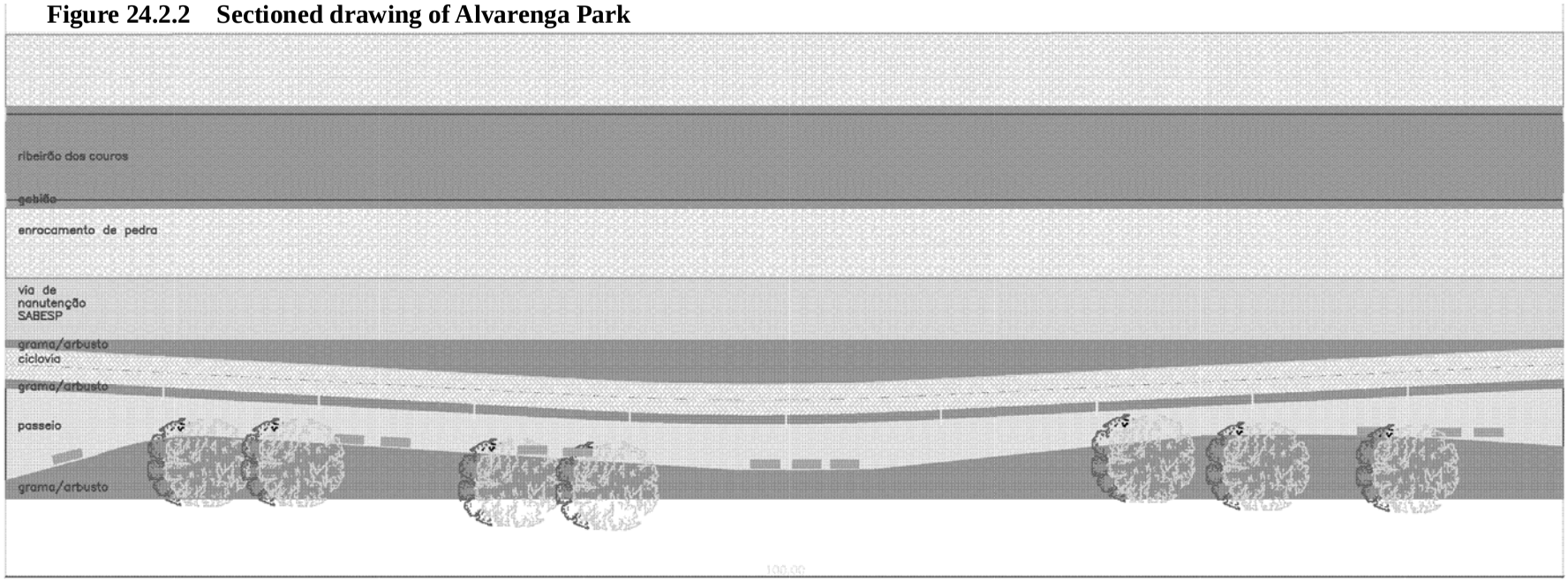


Figure 24.2.3 General design maps of Alvarenga Park

24.3.2 Implementation Schedule

Table 24.3.1 Implementation Schedule of Alvarenga Park

	Item	2007	2008	2009	2010	2011	2012	2013	2014	Remark
Design	Detail Design, Tender				▪▪▪▪▪▪	▪▪▪▪▪▪				
Construction	Alvarenga Park						▬▬			
O&M								▬▬▬	▬▬▬	

24.4 Maintenance

The maintenance in the park requires regular cleaning, refuse disposal, pruning of garden plants and inspection and repair of accessory structures because surrounding residents could feel better anytime. The cleaning and refuse disposal of the park will be taken care of by volunteer activities even though legislatively the park belongs to Sao Bernard do Campo City.

24.5 Project Cost

24.5.1 Construction Cost

Table 24.5.1 Approximate Construction Costs

Item	Cost (R$)	Remark
1. Construction	1,168,454	
Total	1,168,454	

24.5.2 Maintenance Cost

Table 24.5.2 Annual Maintenance Costs

	Maintenance Cost (R$/year)	Remark
1. Wages	11,040	Worker 0.4 person, twice a week
Total	11,040	

Chapter 25

REMEDIATION OF THE OLD SANITARY LAND FILL OF ALVARENGA

25 REMEDIATION OF THE OLD SANITARY LAND FILL OF ALVARENGA

25.1 Outline of the project

(1) Scale of Remediation

Scale of the remediation is about 25 hectares.

(2) Quality of the leachate and its treatment

1) Result of analysis of the quality of leachate of the old sanitary dumping site in Alvarenga

In parts of the sanitary land fill, there were collapses of the fill with waste exposing. Leachate drainage has been observed in some places. A sample of leachate was collected and water quality analysis was performed. Result of the analysis, accomplished by the laboratory of SENAI, is presented in the **Table 25.1.1**.

Also, in the same table, the State Law of Sao Paulo is presented for comparison regarding the substances which can be drained in sewers, in the article 19-TO, paragraph 6th. According to the result of analysis, concentration of BOD, COD and nitrogen (ammonia and nitrite) are high in the leachate. But no big problem was found for leachate drainage to sewer network.

Table 25.1.1 Water Quality of Leachate and Regulation of the State of Sao Paulo

Water Quality Indices	Unit	Regulation of Sao Paulo For release in the sewer system	Quality of the leachate
Hexad chrome	mg/L	1.5	< 0.1
Chrome total	mg/L	5.0	<0.1
BOD	mg/L	-	201
Total Phosphorus	mg/L	-	<1.0
Total Mercury	mg/L	1.5	<0.0002
Soluble magnesium	mg/L	-	1.25
Total nickel	mg/L	2.0	<0.1
Nitrogen amoniacal	mg/L	-	52.4
Nitrogen Kjeldahl	mg/L	-	43.08
Dissolved oxygen	mg/L	-	6.83
SS	mg/L	-	86
Total cadmium	mg/L	1.5	<0.05
Total lead	mg/L	1.5	<0.5
Total copper	mg/L	1.5	<0.1
DQO	mg/L	-	350
Soluble Fe	mg/L	15	<0.5
Total Fe	mg/L	-	1.26
Phosphoric acid	mg/L	-	<1
Nitric Acid	mg/L	-	56.36
Nitrous acid	mg/L	-	<0.5
pH		6 a 10	8.5
Zinc	mg/L	5	<0.1

2) Flow rate of the leachate

As flowrate of the leachate in the site was very small, estimate was done for the calculation. Assumption for the calculation is that pipeline for the leachate collection is buried pipe of diameter 200 mm and 2000 m length after the project. The coefficient of water permeability was deemed as $k=10^{-3}$ cm/s due to the consolidation/subsidence. Hydraulic gradient of the underground water is assumed to be I = 0.01.

Equation of Calculation: Q = A x V

= A x k x i = 0.2 x 2000 = 400 m^2

Q = 400 m2 x 10^{-3} cm/s x 0.01 = 3.46 m^3/day

3) Treatment of the leachate

In spite of its small flowrate, it is a problem to leave the water without treatment to drain for the basin, in terms of management of water quality for drinking water.

As there is need of verification of water quality before treatment, it won't be thrown directly in the sewer system, but transported to sewage treatment plant for treatment.

(3) Existing condition of safety of the fill

Safety against circular sliding of the fill of superior waste is insufficient and improvement with mild slope against sliding is necessary.

Besides, construction of new cover to the existing fill shall make additional subsidence.

(4) Generation of inflammable gas

Already 20 years have passed since this fill was closed in 1987. Occurrence of generation of gas or combustion was not recorded recently. But, explosions/fire due to the generation of methane gas may cause accidents to the users in the future.

Facilities of releasing gas should be considered as necessary minimum facilities and it will make possible monitor generation of gas.

(5) Illegal residents

Illegal residents of about 10 houses are already seen in the site. Care should be paid to make plan of new earth cover and other facilities to avoid transfer.

25.2 Outline of the facility plan

(1) Treatment of the leachate

The leachate collection pipelines shall be constructed centering around the existing outlet of leachate. The collection pipelines consist of perforated pipes and sewers with a reservoir for the leachate at the end of pipelines. The leachate shall be transported by vehicle to the STP of SABESP from the reservoir.

This facility can be built independently from the works of new additional fill (See (2)) for the

improvement of safety of existing fill.

(2) New earth cover

In order to guarantee the safety in the areas of slopes new additional fill shall be made. Measures will be taken to reduce the infiltration of water, which is mixing bentonite in the new cover soil depending on the soil in the site and material of fill. Sheet water proofing method won't be used in the construction. Bench cut shall be applied to the steep slope before applying new earth fill to avoid sliding.

(3) Rain fall run-off

Measure to make infiltration minimize to the underground shall be taken to protect ground water. Also measures to reduce infiltration to the ground, against erosions of the earth due to run off, and flow out outside of the course of channels by jump. In practice, installation of gabion in the steep channel shall be conducted.

(4) Measures against the gas emission

As for emission of gas there was no news on gas recently. However, there have been reported many fire accidents in the world because of leak of methane gas after closure. Gas releasing facilities will be built for extraction and monitoring.

(5) Reforestation

Reforestation will be conducted as preservation measures on the surface layer of the sanitary fill and for the improvement of the landscape. Trees and turf will be planted at the place.

(6) Construction of maintenance and administration

Roads, fences, watch house and lighting fixture will be built for administration and maintenance.

(7) Play ground

There have been a lot of reports regarding accidents caused by the explosion and fires because of generation of methane gas in the closed sanitary fill. Land use for sports and recreation must be made after confirmation of safety from explosion or fire by methane gas.

25.3 Construction Plan

25.3.1 Conditions of the soil

There were many points in which boring were not possible because of obstacles in the layer of waste. Assumption was made using the data of surrounding area out of waste.

25.3.2 Scheme of construction

(1) First year

The existing vegetation will be cut and open roads for construction works. Construction of the

pipes for leachate will be made. Trench for the collection pipes will be filled by crashed stones after the installation of pipes. The end of downstream will be reinforced concrete tank for collection of leachate and transportation.

The extension of the pipeline is about 2,800 m. Besides, fences, gates and watch house will be constructed. It is possible to execute the works of the first year separately from the works after the second year.

(2) Second year

Earth work for new cover shall be made with construction of drainage installation. Maintenance roads and inherent utilities will be built at the same time.

(3) Third year

Drainage installation on the slope, vegetation plantation, lighting fixture and gas releasing facility shall be made.

25.3.3 Construction schedule

The works begin in the year of 2010 and finish in the year of 2012. In the border of the area and surroundings of the site, there are many illegal houses and facilities in the area of Sao Bernardo do Campo and Diadema, and there is need to adjust both construction schedule of this project and moving of the residents.

Table 25.3.1 Remediation of old dumping site of Alvarenga

Classification	Items	2006	2007	2008	2009	2010	2011	2012	2013	Remarks
Planning	Detailed design			▪▪▪▪▪	▪▪▪▪▪	▪▪				
Construction	Improvement of the old sanitary fill					▬▬	▬▬	▬▬		

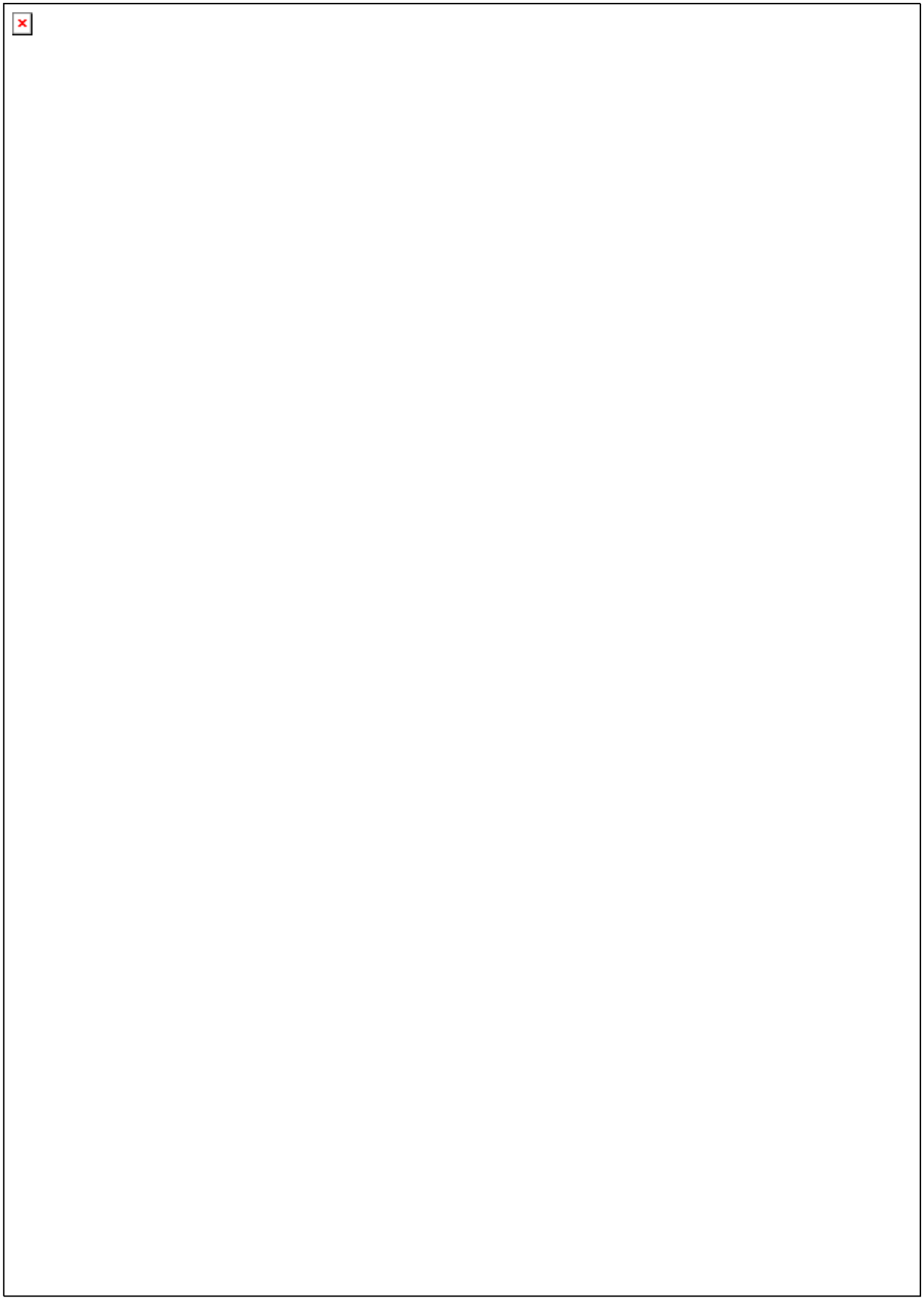


Figure 25.2.1 Remediation of the Old Sanitary Land fill of ALVARENGA (1)

Figure 25.2.2 Remediation of the Old Sanitary Land fill of ALVARENGA (2)

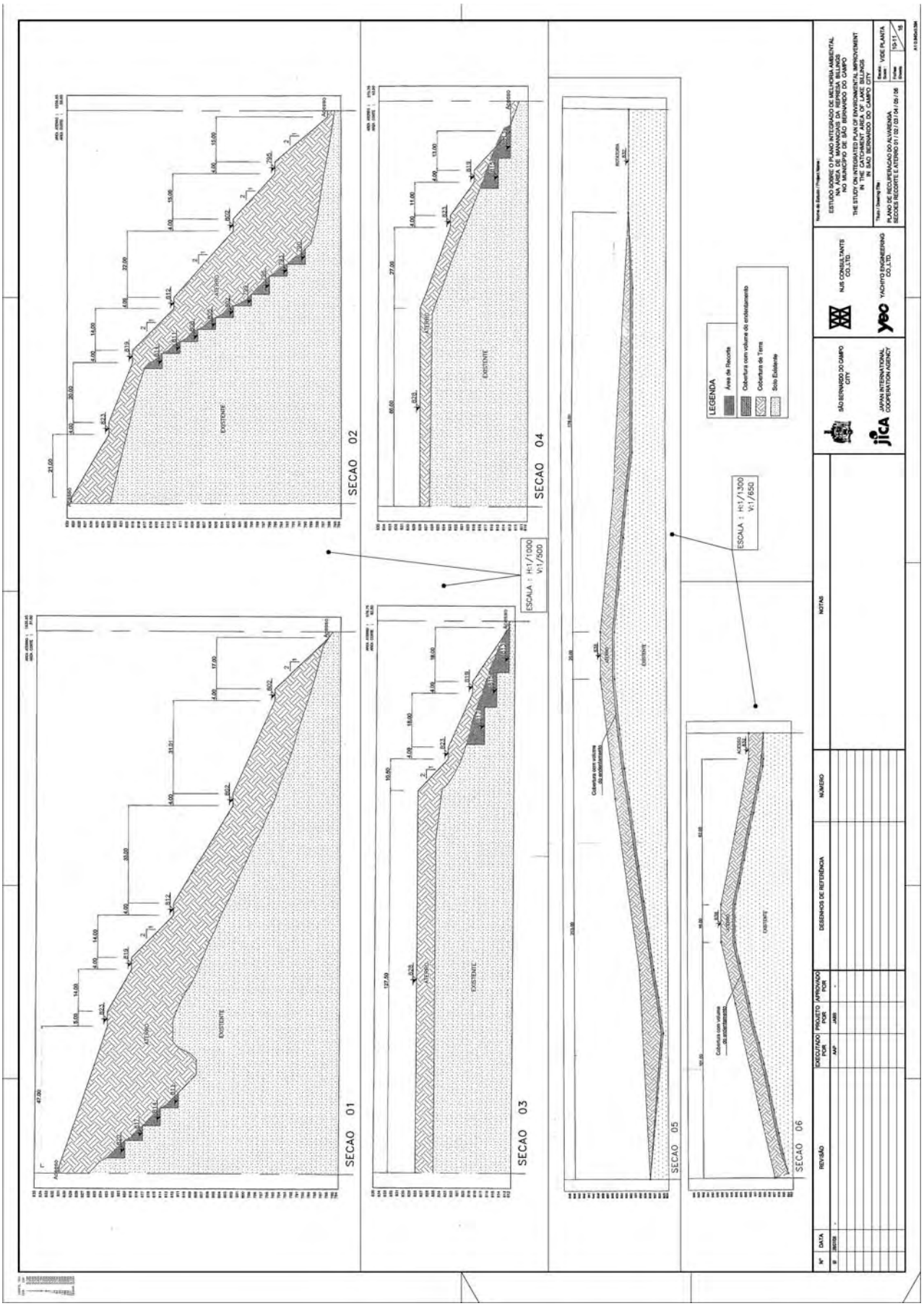


Figure 25.2.3 Remediation of the Old Sanitary Land fill of ALVARENGA (3)

25.4 Maintenance and Administration

It is believed that the negative impact on the environment due to generation of gas, subsidence of the land and leachate will be stabilized after years. But generation of gas must be precisely verified prior to the land use such as playground.

As for the leachate, real flow rate shall be confirmed at the maintenance stage.

25.5 Project Cost

25.5.1 Construction Cost

The construction cost of the work is 12 million Real (624 million yens).

If construction is limited to leachate treatment, that is pipelines and reservoir, the cost shall be 2.1 million Real (109.2 million yens) 18% of the total project cost.

Table 25.5.1 Estimate of the project cost of Remediation of old dumping site of Alvarenga

Item	Cost	Remarks
1. Facilities in low land	2,116,052	Installation of leachate collection and administrative facilities
Sub-total	**2,116,052**	
2. Maintenance road in low land, facilities for leachate	1,458,583	Roads of the areas of low land / Run-off
3. Earth work	6,172,570	New cover the fill with earth in high land
4. Facilities of high land	2,217,770	Planting / gas releasing facility
Sub-total	**9,848,923**	
Total	**11,964,975**	
	11,965,000	

25.5.2 Maintenance Cost

Table 25.5.2 Annual Expense of Maintenance of Old dumping site of Alvarenga

	Annual expense for maintenance (R$ / year)	Remarks
Light	2,000	Capacity of the fixture 5 kW
Fuel	11,000	Vehicle for maintenance use
Transport	20,000	Leachate
Treatment of the leachate	13,000	
Employees' wage	83,000	3 workers
Total	**671,000**	

Chapter 26

WATER TREATMENT BY AQUATIC PLANTS

26. WATER TREATMENT BY AQUATIC PLANTS

26.1 Fundamentals

(1) Aquatic plants

As aquatic plant to be used, water hyacinth was chosen from its floating characteristics on the water.

Though fixed growing aquatic plant such as reeds is used widely for this purpose, its use is limited by the depth of the water for cultivation. The depth of the water is up to 1 m (the ideal depth is 0.6 m), but shallow and broad topographies are not very common in the Billings Lake. It would be necessary to make broad shallow water area artificially by soil filling. It is not possible to assure to improve the water quality unless great area is secured in each of the arms, as unit treatment capacity of the system is very low compared with sewage treatment plant. Also, water surface of the Billings Lake is property of EMAE and it is not desirable to decrease the capacity of water of the Billings Lake for its objective.

Method of using aquatic plants, when compared to artificial systems, it is clearly limited in terms of load intensity. The water quality of Ribeirao of Alvarenga and adjacencies are badly polluted (DBO from 300 to 400 mg/L) like raw sewage and to treat such sewage it is necessary an extremely extensive area. (Unit treatment capacity is 200 to 300 m^3/dia for the aquatic plant treatment).

Growth of mosquitos is major concern for the aquatic plant using treatment method. In the Sao Paulo region bush is frequently cut to control the reproduction of mosquitos transmitters of the Dengue Fever.

However, the problem of the growth of mosquitos is similar in case of water hyacinth. Still, as the growth speed of the water hyacinth is extremely fast, careful attention must be paid to avoid spread over the Lake..

(2) Objective

As the effect and the hazard of using water hyacinth is not well understood, to construct full-scale purification system is problematic. It is desirable to install small experimental plant to get the operation data and to make maintenance manual under the administration of the Environmental Protection Center.

The harvested water hyacinth, besides being used as biomass for energy collection from sludge treatment process, will be studied in the Environmental Protection Center to be used as fertilizer. Study on growth of mosquitos and larvae, its relation to Dengue fever in connection with the water hyacinth shall be made as well.

(3) Location of the facility

The location of the plant will be in the arm where the flowrate of water doesn't increase drastically during the rains to avoid wash away by flooding. Convenience of transportation of harvested hyacinth must be considered as well. For these reasons, Ribeirao das lavras was the chosen for the arm and facility shall be constructed in front of ETE Pinheirinho.

(4) Experiment Scale

The density of the water hyacinth after growth reaches 80 kg/m2, that is 800 tons of harvest for a hectare. Depending on its scale and method of management, harvesting might needs long days and a lot of workforce in the activity. It indicates that if the water hyacinth are washed away to the outside of the boundary and grow here and there, it might become a big problem of water pollution and harvesting in the inappropriate location. Thus, it will need severe control with installment of fences and cultivation inside the area to prevent wash away.

Facility shall be constructed in full width of 150m in the arm in front of ETE Pinheirinho, with the width of 10m. This configuration will make it possible to get the data of effect of facility.

26.2 Outline of facility design

(1) Water hyacinth cultivation area

Water hyacinth strip shall be about 15 m width, so that it forms a right angle to the flow of Ribeirao das lavlas. So that the water hyacinth strip is not washed away by water flow, they shall be fixed by floating fences which is anchored by steel wires to the bottom.

(2) Maintenance deck for management

In order to maintain and control the water hyacinth area from stable deck panel, maintenance deck shall be constructed on the water. The deck shall be 1m high from the water surface with 3 deck ways with 2m x 150m in rows to do harvest activities even without machines/boat and collecting water samples. Still, as the installation area is property of EMAE, it is desirable that the construction material is easy to dismantle.

26.3 Construction Plan

26.3.1 Condition of the soil

Investigation of the soil condition of the site was not conducted. Detailed investigation shall be made during basic study stage.

26.3.2 Construction plan

(1) Maintenance Deck

To avoid construction works on the water using boats, deck shall be constructed from the shore. Construction work shall be proceeded by heavy machine on the deck towards the opposite bank.

(2) Floating fence

Floating fences shall be fixed on the bottom of the Lake and steel pile of the deck.

(3) Seeding

Seeding of the water hyacinth shall be made in the beginning.

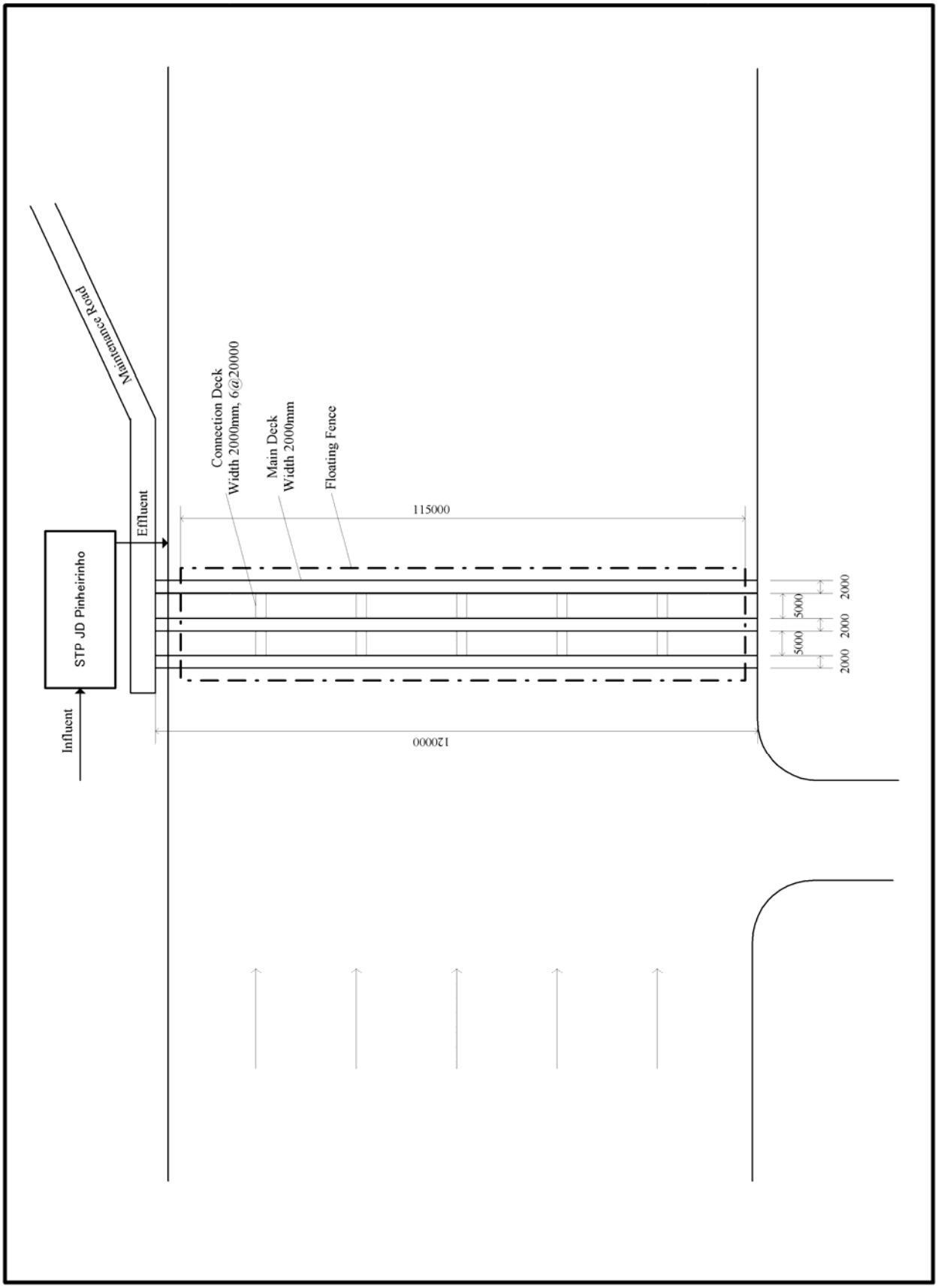


Figure 26.3.1 Plan of Water treatment by aquatic plants

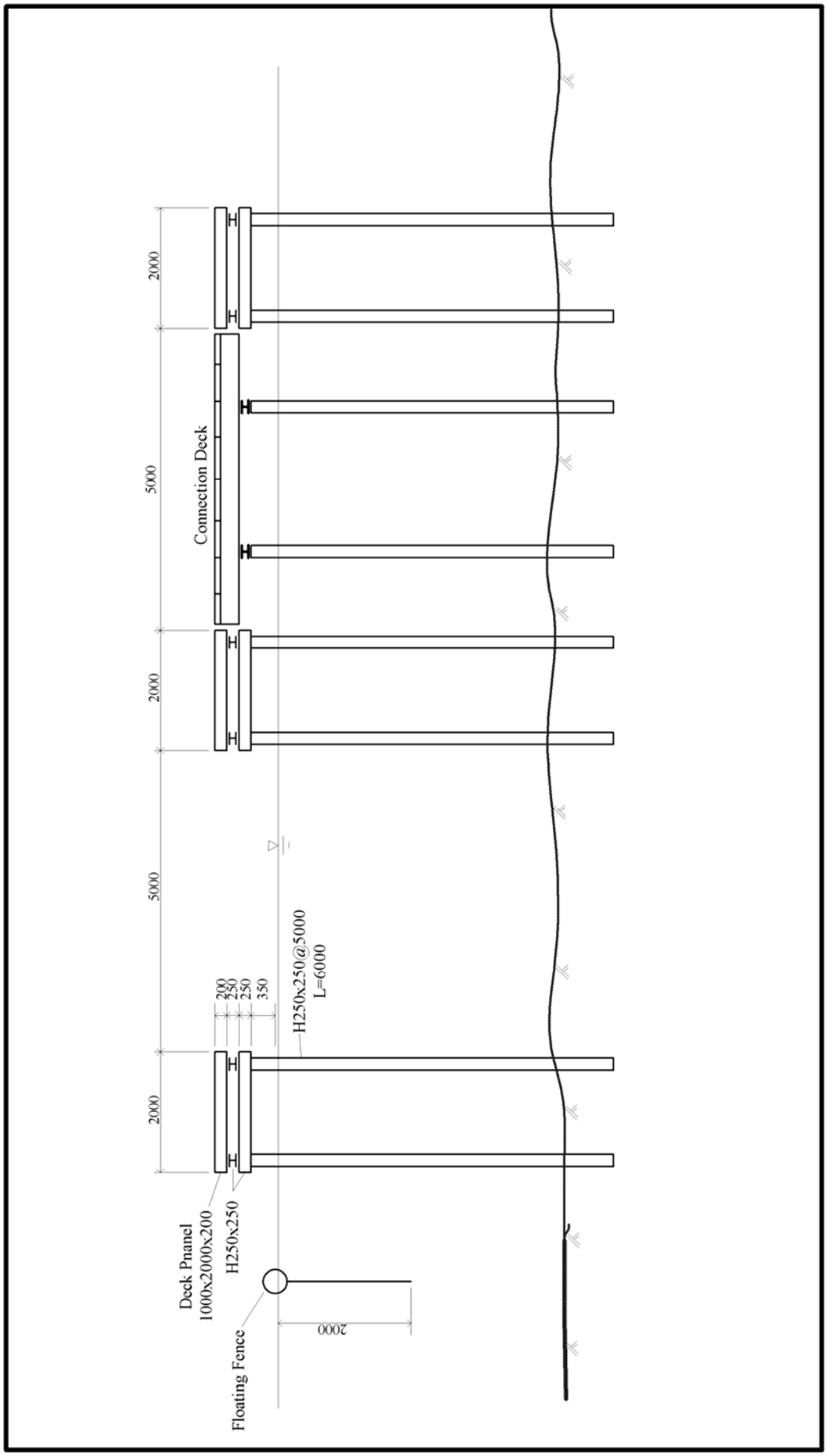


Figure 26.3.2 Sectioned drawing of Water treatment by aquatic

26.3.3 Construction schedule

Construction begins in 2010 and ends in the same year.

Table 26.3.1 Construction schedule of the experimental system

classification	Work item	2006	2007	2008	2009	2010	2011	2012	2013	Remarks
Planning	Detailed design			▪▪▪▪▪▪	▪▪▪▪▪▪					
Construction	Experimental system					▬▬				

26.4 Maintenance

The water hyacinth floats on the water and its growth is extremely fast. Withering and decomposition of plants in the water bottom makes pollution of water. Therefore, floating fence shall be installed to impede the water hyacinth disperses, and it is important to harvest regularly and clean the bottom of the lake.

26.5 Project Cost

26.5.1 Construction cost

The cost of the whole work is of 665 thousand real (35 million yens).

Table 26.5.1 Construction cost of the experimental purification system

Item	Construction cost	Remarks
1. Floating Fence	52,000	length 350 m
2. Installation of fence	26,000	
3. Steel structure	117,000	Steel 900 m^2
4. Deck Panel	468,000	1000x2000
5. Seeding	2,000	
Total	665,000	

26.5.2 Maintenance cost

Table 26.5.2 Maintenance cost of the experimental system of purification with aquatic plants

	Maintenance cost(R$ / year)	Remarks
Electricity	0	
Fuel	11,000	Administrative vehicle
Transportation	4,000	Harvested water hyacinth
Employees' wage	83,000	3 workers
Total	98,000	

Chapter 27

ENVIRONMENTAL PROTECTION CENTER

(Center of Environmental Experience/Study and Center of Monitoring of the Water Quality)

27. ENVIRONMENTAL PROTECTION CENTER

(Center of Environmental Experience/Study and Center of Monitoring of the Water Quality)

27.1 Fundamentals

As a result of the deliberation among the partners (Sao Bernardo do Campo, SHAMA and SABESP), in relation to the Center of Environmental Experience/study and Center of Monitoring of the Water Quality, it was resolved that maintaining the respective functions both institutions should be integrated as "Environmental Protection Center"

(1) Center of Environmental Experience/Study

1) People intended:

Students: children's group, students and related students in the state of SP.

Residents of the basin: citizens in the Basin

2) Basic program

(a) Experience-study classes of the Environment for the Elementary school children

Experience-study classes will be conducted in the Floating school (schooling on the boat), Landing School (schooling with focusing in visits to companies) and experience-study classes in the Center. Depending on the need, lodgings will be possible.

(b) Courses for the residents of the basin

Classes will be offered to the residents of the basin (Facts on the cycle of the water, history of the Billings lake, meaning of an area of preservation of the water quality, appropriate use of the resources, sewerage system that includes the Billings Lake and surroundings, need of the system of sewage treatment, legislation regarding the preservation of the basin, etc). Activities of explanations will be accomplished about the preservation of the environment for the residents of the basin as well as exhibitions, seminars and debates.

3) Basic facilities / equipments

(a) Basic facilities

- Room of Exhibition
- Room of Experience-study (capacity for about 100 people) classes
- Room of materials for study (room of research of information)
- Room of meetings (capacity for about 50 people)
- Dining hall
- Bedrooms
- Administration office / Room

- Harbor

(b) Equipments

- 1 boat to the Flotation School;
- 2 bus;
- Vehicle for use of the administration;
- 5 computers;
- Air conditioning equipment;
- Antenna for cable TV;
- Furniture;
- Emergency Electric generator ;
- Kit for Experience-study (simple kit for analysis of water quality);

(2) Center of Monitoring of the Water Quality

It will accomplish the water sampling/measurements of the quality of the water of the Billings Lake in an independent way with SABESP and CETESB. Except for the parameters of the special indices, it will be possible to measure the parameters in an autonomous way.

The facility will be designed to open the activity to visitors for experience/study.

(3) Construction site

Parking lot beside Parque Estoril zoo was chosen for the lot for the facility. The lot is located in the forest of Estril opening to Rio Grande, which is also suitable for the harbor for floating school.

The two functions shall be integrated with unifying two buildings as one.

27.2 Outline of Design

The plan of facility and installation are shown in the **Figure 27.2.1** to **27.2.3**. In front of the facility, harbor will be built in the Rio Grande, guaranteeing the access to the Flotation School. As the harbor will be built in environment preservation area, it will be necessary to get an environmental licensing for its construction. For the Billings, the boat will be transported from the harbor to Parque Estoril's marina depending on needs.

The parking will be built close to the facility in the walking distance. For the parking an existent bare land will be used not to hurt vegetation of the existing forest.

27.3 Construction Plan

27.3.1 Soil Condition

The facility shall be built in a plane area. Basically the bearing capacity of this area is not strong enough to support the weight of facility. Piles for support weights might be needed.

27.3.2 Construction Plan

The lot is being used now as parking and for that there are minimum needs of preparation works and temporary constructions. Also, there is no need to cut vegetations in the forest. The transport of the equipments will be made through the existing roads. It is necessary to take safety measure for the chair lift during the work, because it may continue operation to the existing zoo. As the cable passes on the roads of the Environmental Protection Center, it is necessary to take care for the operation of the cranes used in the construction.

Figure 27.2.1 Location map of Environmental Protection Center

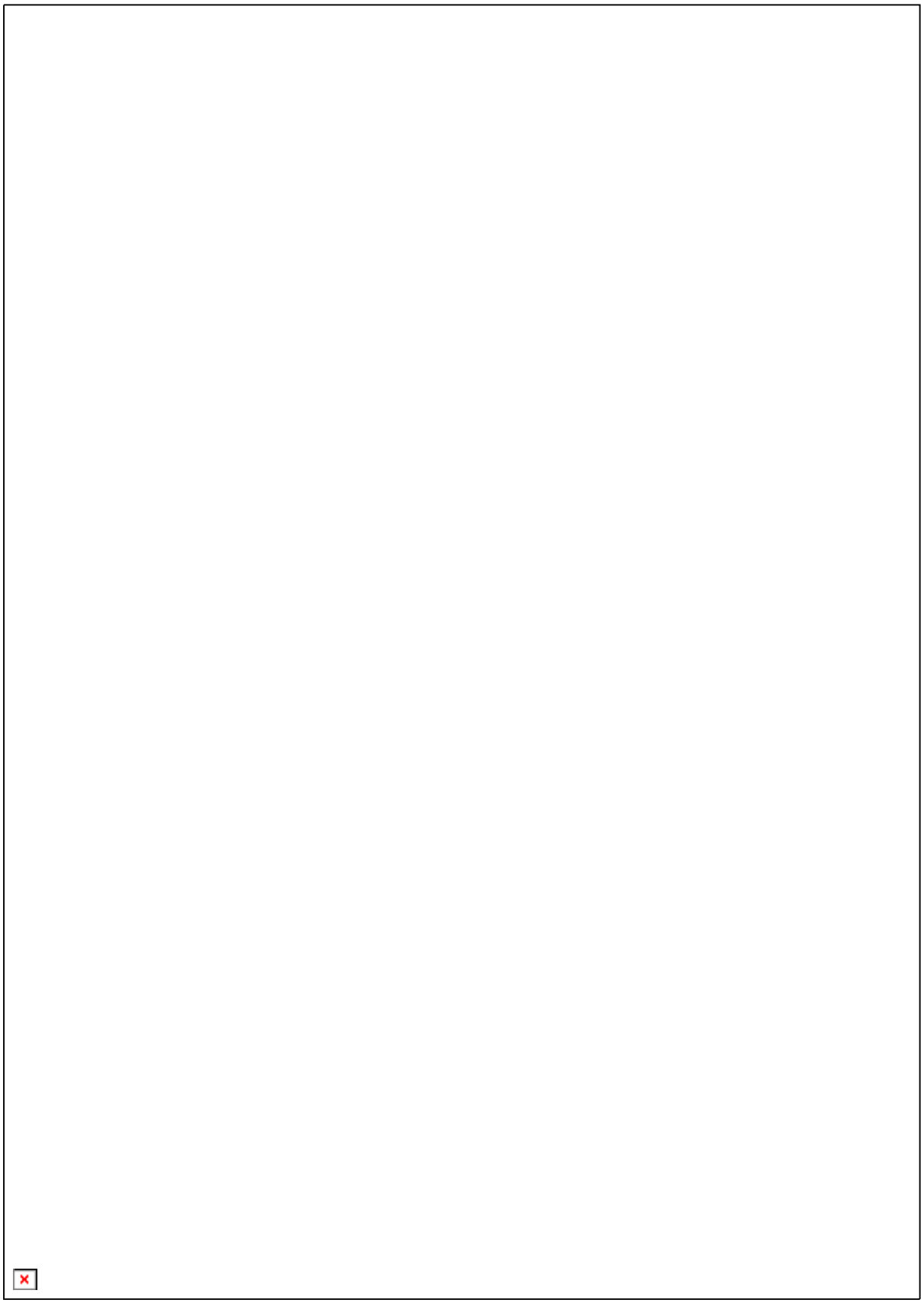


Figure 27.2.2 The plan of Environmental Protection Center

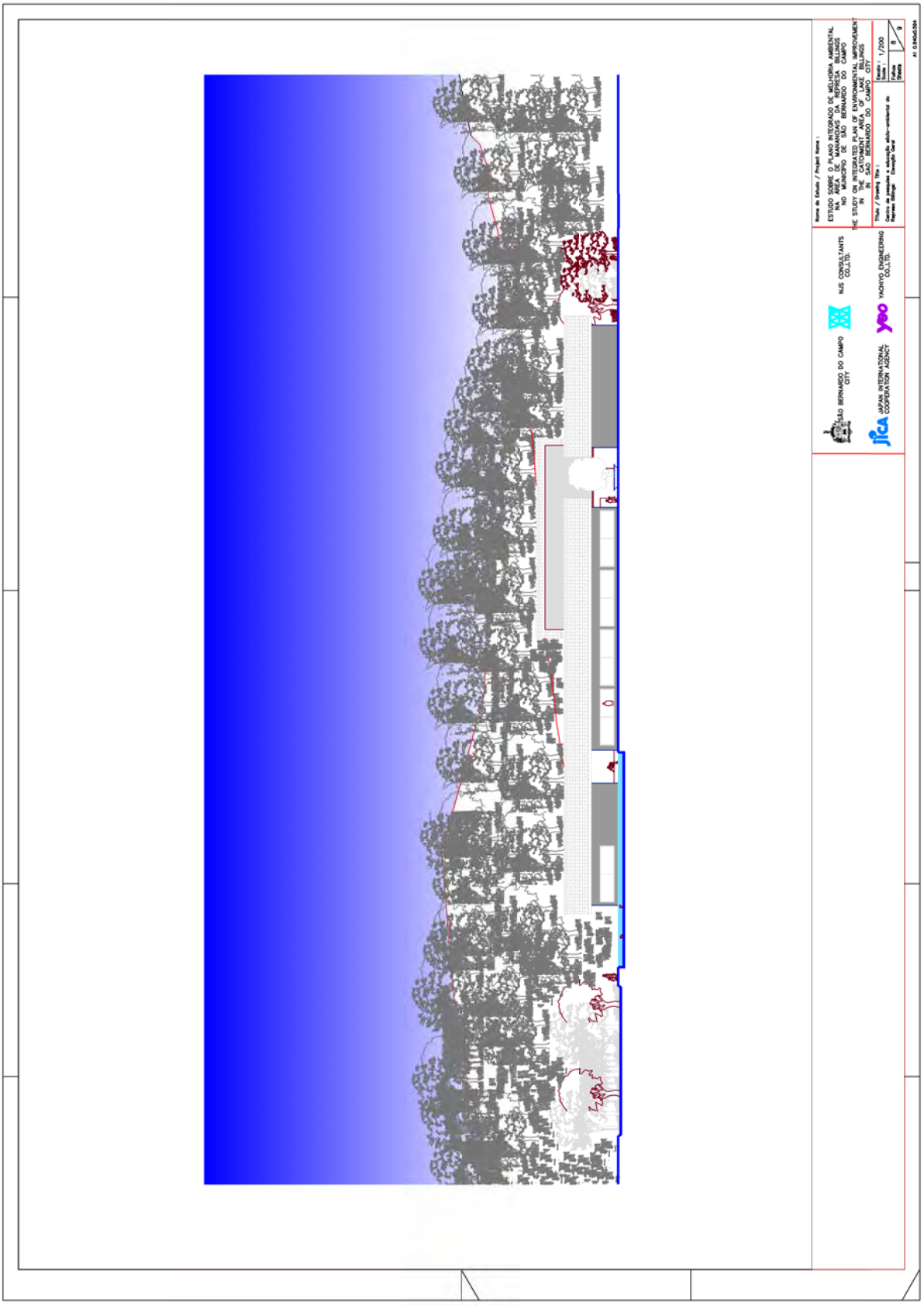


Figure 27.2.3 The installation of Environmental Protection Center

27.3.3 Construction Schedule

Table 27.3.1 Environmental Protection Center

Classification	Item	2006	2007	2008	2009	2010	2011	2012	2013	OBS
Planning	Detailed planning of the construction			▪▪▪▪▪	▪▪▪▪					
Construction	construction of the Center					▬▬▬	▬▬▬			

27.4 Project Cost

27.4.1 Construction Cost

Table 27.4.1 Construction Cost of the Environmental Protection Center

Item	Construction Cost	Remarks
1. Construction work	3,240,337	
2. Internal facilities	517,074	
3. Supplemental constructions	775,611	
4. Furniture	34,472	
5. Roads	1,090,565	
6. Vehicles / boat	2,083,500	
7. Equipment for analysis of the quality of the water	410,420	21,387,000 yens
8. Glassware for analysis of the water quality	5,624	293,080 yens
9. Chemical products	22,574	1,176,318 yens
Total	8,180,177	

27.4.2 Maintenance cost

Table 22.4.2 Annual Expense of Maintenance of the Environmental Protection Center

	Annual expense of maintenance (R$ / year)	Remarks
Electricity	21,000	Capacity of the installation 50 kW
Fuel	110,000	For cars and boats
Consumable goods for analysis of the water	2,000	
Water Supply	4,000	
Sewage	2,000	
Employees' wage	1,242,000	
Total	1,381,000	

Chapter 28

MEASURES OF SOFT COMPONENT

28. MEASURES OF SOFT COMPONENT

The relationship among measures with software, the Municipality of Sao Bernardo do Campo, the Environmental Centre and the Association for "Clean the Lake Billings" is described herein.

In the Municipality of Sao Bernardo do Campo, the Education and Culture Department is responsible for public enlightening and environmental education for schoolchildren and teachers, while the Housing and Environment Department (SHAMA) for the public and leaders of communities and NGOs, respectively, with the following purposes:

- Improvement of environmentally-friendly life style and business style
- Recognition of significance and importance of involvement of activities for improvement of basin wide environment
- Enforcement of laws and administrative guidance

The environmental Centre is positioned as the place for practical experience and managed independently by the Municipality of Sao Bernardo do Campo for the immediate stage.

However, it is difficult to attain the improvement of basin wide environment of the Lake Billings and Rio Grande Arm with the endeavor of the Municipality of Sao Bernardo do Campo only and therefore important to cooperate and combine all the stakeholders for the environment. The Association for "Clean the Lake Billings" is proposed as the mechanism for such attainment with the objects that all the stakeholders for the basin form an agreement and tackle the improvement of environment sharing the roles each other.

When the operation of the Association for "Clean the Lake Billings" will be working well, It is desirable that the Association will be shifted from sole management by the Municipality of Sao Bernardo do Campo to joint management by the municipalities involved in the basin, making the Environmental centre open to the people.

The subjects for public enlightening and environmental education include the following, but are not limited to:

(1) Improvement of environmentally-friendly life style and business style

- Proper use of groundwater
- Reduction of water consumption
- Reduction of load from the kitchen, etc. derived from domestic wastewater

(2) Activities for improvement of basin environment

- Restoration of natural forestry
- Cleaning of lakeside

- Cleaning of rivers and streams
- Removal of water bloom and algae

(3) Enforcement of laws and administrative guidance

- Installation of septic tanks and their proper maintenance
- Proper land use
- Improvement of fertilizer spreading and so on
- Protection of soil runoff from the farmland

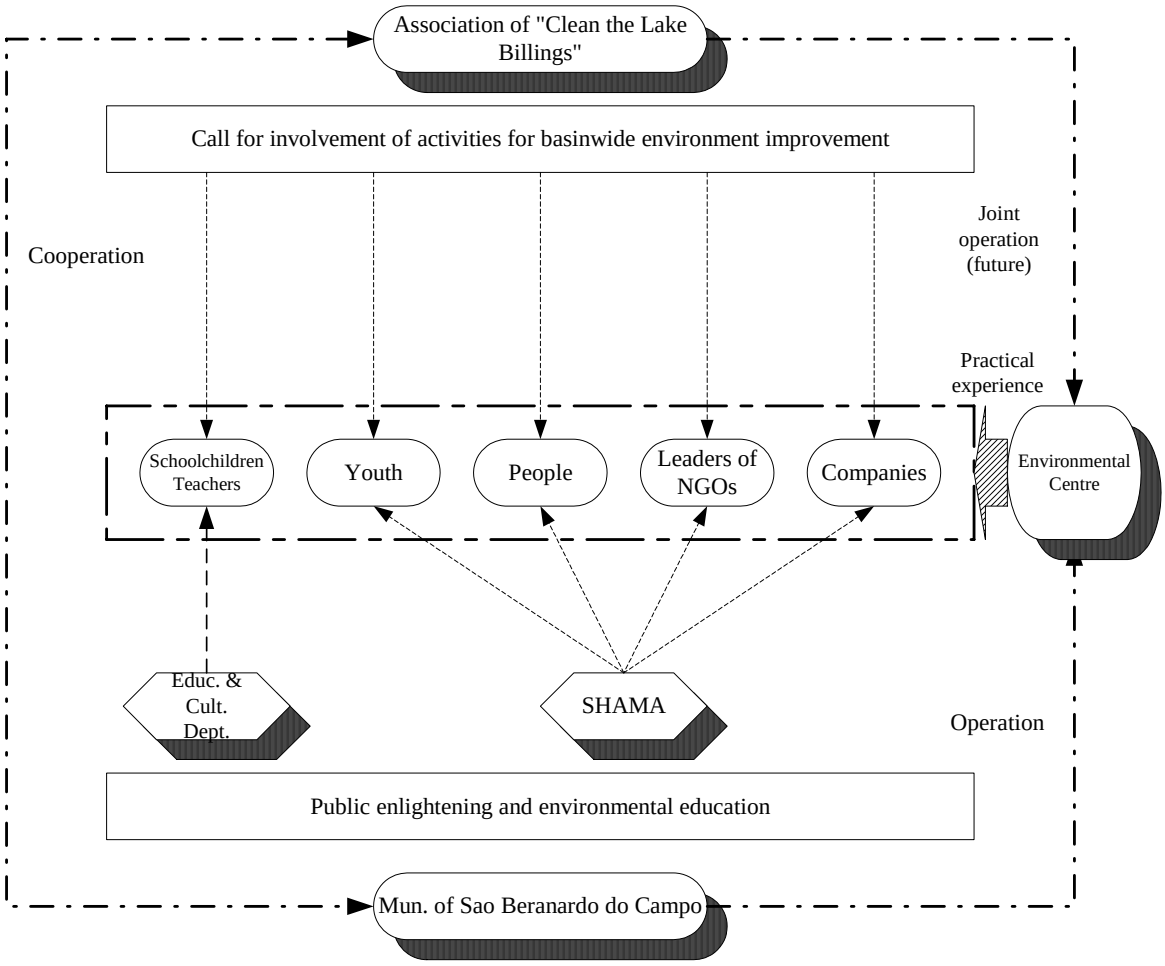


Figure 28.1.1 Image of implementation of measures with softcomponent

Chapter 29

FINANCIAL PLAN

29. FINANCIAL PLAN

SBC and SABESP carry out priority projects of the Lake Billings Water Quality Improvement Program. Financial plans by each executing agency are shown below;

SBC jurisdiction projects

1) Environmental Center
2) Permeable Pavement
3) Remediation of the former Alvarenga solid waste dumping site
4) Installation of a pilot plant for lake purification using aquatic plants
5) Construction of the Alvarenga Park

SABESP jurisdiction projects

1) Sewerage construction in the urban areas
2) Sewerage construction in the isolated communities

29.1 Financial plan of SBC jurisdiction projects

Cost estimations for SBC jurisdiction projects are explained in detail in **Chapter 23** for Permeable Pavement, in C**hapter 24** for Construction of the Alvarenga Park, in **Chapter 25** for Remediation of the former Alvarenga solid waste dumping site, in C**hapter26** for Installation of a Pilot Plant for Lake Purification Using Aquatic Plants and in **Chapter 27** Environmental Center. These are summarized in **Table 29.1.1**.

Total investment cost of five projects is 52,913,000 R$. Permeable pavement is 27,691,000 R$ as the biggest (52%). Remediation of the former Alvarenga solid waste dumping site is 12,803,000 R$ (24%). Environmental Center is 8,766,000 R$ (17%). Construction of the Alvarenga Park is 2,942,000 R$ (6%). Installation of a pilot plant for lake purification using aquatic plants is 712,000 R$ (1%).

Operation and Maintenance (O&M) cost is 1,619,000 R$ in every year for five projects. O&M cost by project is reverse order of investment cost: Environmental Center is 1,380,000 R$ (85%) as the biggest, the former Alvarenga solid waste dumping site 128,000 R$ (8%). Installation of a pilot plant for lake purification is 98,000 R$ (6%), Construction of the Alvarenga Park 11,000 R$ (0.7%). Permeable pavement is 2,000 R$ (0.1%). These show that management administration is the most important for the implementation of Environmental Center.

29.1.1 Cost estimates of SBC jurisdiction projects

(1) Environmental Center

The investment expense was estimated in total at 8,766,000 R$. As for the breakdown, , laboratory-related building expense (include public works) 5,658,000 R$ (65%), vehicle and ship is 2,084,000 R$ (24%), facilities 451,000 R$ (5%), consulting fee 573,000 R$ (7%); (Refer to **Annex A29.1.1** for investment expense yearly plan).

O&M cost is estimated at 1,379,000R$ every year. The breakdown is personnel expenses 1,242,000R$ (90%), fuel cost 110,000R$ (8%), electricity costs 21,000 R$ (1%), water and wastewater cost 6,000 R$ (0.4%) (Refer to **Annex A29.1.6** for O&M cost yearly plan).

(2) Permeable Pavement

The investment expense was estimated in total at 27,691,000 R$. As for the breakdown, permeable pavement cost is 23,396,000R$ (84%) rainwater drainage cost is 2,483,000 R$ (9%), consulting fee is 1,812,000 R$ (7%); (Refer to **Annex A29.1.2** for investment expense yearly plan).

O&M cost is estimated at 2,000 R$ every year. This is road washing expense for 1 time a year blocking cancellation; (Refer to **Annex A29.1.7** for O&M cost yearly plan).

(3) Remediation of the former Alvarenga solid waste dumping site

The investment expense was estimated in total at 12,803,000R$. As for the breakdown: preparations cost is 3,575,000R$ (28%), public works cost 8,390,000R$ (66%), consulting fee 838,000 R$ (7%); (Refer to **Annex A29.1.3** for investment expense yearly plan).

O&M cost is estimated at 128,000 R$ every year (Refer to **Annex A29.1.8** for O&M cost yearly plan).

(4) Installation of a pilot plant for lake purification using aquatic plants

The investment expense was estimated in total at 712,000 R$. As for the breakdown: Installation cost 665,000R$ (93%), consulting fee 47,000R$ (7%); (Refer to **Annex A29.1.4** for investment expense yearly plan).

O&M cost is estimated at 98,000 R$ every year (Refer to **Annex A29.1.9** for O&M cost yearly plan).

(5) Construction of the Alvarenga Park

The investment expense was estimated in total at 2,942,000 R$. As for the breakdown: construction cost is 1,168,000R$ (40%), consulting fee 82,000 R$ (3%), site costs is 1,692,000R$ (58%). The ratio of site costs is high, and there seems to be a problem for realization of project (Refer to **Annex A29.1.5** for investment expense yearly plan).

O&M cost is estimated at 11,000 R$ every year (Refer to **Annex A29.1.10** for O&M cost yearly plan).

Table 29.1.1 Cost Estimation for Priority Projects: SBC jurisdiction

	Local Currency Portion	Foreign Currency Portion	Total Cost	Total Cost (equiv. Yen)
	1000R$	1000R$	1000R$	1000Yen
Five projects total				
Investment cost	49,123	3,789	52,913	2,757,271
O&M cost per year	1,619	0	1,619	84,347
Environmental Center				
Building cost	5,658	0	5,658	294,841
Vehicle & ship	2,084	0	2,084	108,571
Laboratory/facilities	12	410	422	22,012
Laboratory glass	0	6	6	293
Laboratory/ chemical reager	0	23	23	1,176
Total	7,754	439	8,192	426,894
Consulting fee	0	573	573	29,883
Investment cost total	7,754	1,012	8,766	456,777
Basic electricity charges	6	0	6	313
Demand electricity charge	15	0	15	782
Fuel cost	110	0	110	5,732
Personnel expenses	1,242	0	1,242	64,721
Laboratory maintenance cos	1	0	1	52
Water charge	4	0	4	208
Sewage charge	2	0	2	104
O&M cost per year	1,380	0	1,380	71,912
Permeable pavement				
Permeable pavement	23,396	0	23,396	1,219,166
Rainwater drainage	2,483	0	2,483	129,389
Consulting fee	0	1,812	1,812	94,399
Investment cost total	25,879	1,812	27,691	1,442,954
O&M cost per year	2	0	2	104
Remediation of the former Alvarenga solid waste dumping site				
Preparations cost	3,575	0	3,575	186,293
Public works cost	8,390	0	8,390	437,203
Consulting fee	0	838	838	43,645
Investment cost total	11,965	838	12,803	667,141
Basic electricity charge	1	0	1	31
Demand electricity charge	1	0	1	52
Fuel cost	11	0	11	573
Personnel expenses	83	0	83	
Shipping expenses	19	0	19	990
Anti-exudate measure cost	13	0	13	677
O&M cost per year	128	0	128	6,649
Installation of a pilot plant for lake purification using aquaticr plants				
Construction cost	665	0	665	34,653
Consulting fee	0	47	47	2,426
Investment cost total	665	47	712	37,079
Fuel costs	11	0	11	573
Personnel expenses	83	0	83	4,325
Transportation costs	4	0	4	208
O&M cost per year	98	0	98	5,107
Construction of the Alvarenga Park				
Construction cost	1,168	0	1,168	60,888
Consulting fee	0	82	82	4,262
Land cost	1,692	0	1,692	88,170
Investment cost total	2,860	82	2,942	153,320
Personnel expenses	11	0	11	575
O&M cost per year	11	0	11	575

Exchange rate: 52.11 Yen/R$

29.1.2 Funding plan of SBC jurisdiction projects

The Municipality of Sao Bernardo do Campo (SBC) as an executing agency has intention to use Yen loan (JBIC) besides self-fund. Yen loan is applied to only funds for investment cost except the land purchase and cannot apply operation and maintenance cost.

Although application of Yen loan is not decided, assuming the condition of Yen loan, finance source of the projects is sorted. When project cost was estimated, that was divided into Local Currency Potion and Foreign Currency Potion. The foreign currency potion assumed 100% JBIC fund and Local Currency Potion assumed self-fund of SBC 25% and JBIC fund 75%.

The result of the above-mentioned journalizing work is summarized in **Table 29.1.2**. Investment cost of five projects is 52,913,000 R$, and it is served 13,550,000 R$ (26%) by SBC self-fund and 39,363,000 R$ (2,050,000,000 yen) (74%) by JBIC fund. O&M cost 1,619,000 R$ per year is funded by only self-fund of SBC.

As mentioned in **Chapter 18** economy / financial analysis of the Master Plan, SBC has credibility of direct loan based on financial responsibility law according to financial data in 2004. In other words a basic condition to request Yen loan satisfies it.

SBC does not assume any income from these projects. On this account the influence that these projects give SBC municipal finance lasts for long terms from the business start year to repayment completion of a yen loan. SBC will bear indispensability expense. An indispensability fund of each year is calculated as follows:

(Investment cost by SBC) + (Interest and repayment of Yen Loan) + (Operation and maintenance cost)

The investment cost by SBC could be funded by general budget of SBC and might be funded by donation from company and citizen beside general budget. In addition, operation and maintenance cost might be assisted by NGO volunteer and technical cooperation of JICA. The alternative financial plan is explained focused on Environmental Centre among five projects.

Table 29.1.2 Fund plan of SBC jurisdiction Projects

	Total Cost	SBC fund	JBIC yen loan	JBIC yen loan (equiv. Yen)
	1000R$	1000R$	1000R$	1000Yen
Five projects total				
Investment cost	52,913	13,550	39,363	2,051,193
O&M cost per year	1,619	1,619	0	0
Environmental Center				
Building cost	5,658	1,415	4,244	221,131
Vehicle & ship	2,084	521	1,563	81,428
Laboratory/facilities	422	3	419	21,856
Laboratory/glass	6	0	6	293
Laboratory/chemical reagent	23	0	23	1,176
Sub-total	8,192	1,938	6,254	325,885
Consulting fee	573		573	29,883
Investment cost total	8,766	1,938	6,827	355,767
Basic electricity charges	6	6	0	0
Demand electricity charge	15	15	0	0
Fuel cost	110	110	0	0
Personnel expenses	1,242	1,242	0	0
Laboratory maintenance cost	1	1	0	0
Water charge	4	4	0	0
Wastewater charge	2	2	0	0
O&M cost per year	1,380	1,380	0	0
Permeable Pavement				
Permeable pavement	23,396	5,849	17,547	914,374
Rainwater drainage	2,483	621	1,862	97,042
Consulting fee	1,812	0	1,812	94,399
Investment cost total	27,691	6,470	21,221	1,105,815
O&M cost per year	2	2	0	0
Remediation of the former Alvarenga solid waste dumping site				
Preparations cost	3,575	894	2,681	139,720
Public works cost	8,390	2,098	6,293	327,902
Consulting fee	838		838	43,645
Investment cost total	12,803	2,991	9,811	511,267
Basic electricity charges	1	1	0	0
Demand electricity charge	1	1	0	0
Fuel costs	11	11	0	0
Personnel expenses	83	83	0	0
Shipping expenses	19	19	0	0
Anti-exudate measure costs	13	13	0	0
O&M cost per year	128	128	0	0
Installation of a pilot plant for lake purification using aquatic plants				
Construction cost	665	166	499	25,990
Consulting fee	47	0	47	2,426
Investment cost total	712	166	545	28,416
Fuel cost	11	11	0	0
Personnel expenses	83	83	0	0
Transportation cost	4	4	0	0
O&M cost per year	98	98	0	0
Construction of the Alvarenga Park				
Construction cost	1,168	292	876	45,666
Consulting cost	82	0	82	4,262
Land cost	1,692	1,692	0	0
Investment cost total	2,942	1,984	958	49,928
Personnel expenses	11	11	0	0
O&M cost per year	11	11	0	0

Exchange rate 52.11 Yen/R $

29.1.3 Financial Alternatives of SBC jurisdiction Projects

Above mentioned financial plan is complied with a policy of SBC that three projects will not anticipate income. However, from a point of view of sustainability, financial alternatives are examined. Especially Environmental Centre should be considered as income gain project, because it is a symbolic project of the Lake Billings and it has various stakeholders (municipalities in basin area, companies in basin area, lake owner, SABESP and residents in the basin area) who receive beneficiary (refer to **Annex 29.1.11**).

Regarding Environmental Centre, cost-benefit analysis is conducted on the condition as follows:

Table 29.1.3 Financial Alternatives of Environment Centre

Case	Condition
A	Basic case: it does not anticipate any income
B	Admission fee and seminar fee (leader at community, the group of staff of a school training) are accounted as income.
C	In addition to case B, assume others income. Ante of basin-related cities, a donation from companies, donation from citizen, subsidy from aquatic resources fund, exhibition charges in events, the institution fee for use, sale profit of the environment teaching materials are accounted as income.
D	O&M cost (particularly, staff salary) is reduced by NGO volunteer reduction and gratuitous technical cooperation of JICA. 30% reduction of salary is assumed from basic plan
E	Case B, C, and D are fused. It is a consolidated plan on income and cost.

Table 29.1.4 shows the results of cost-benefit of an Environmental Centre project on the above-mentioned premise. Case E is FIRR 2.7%, NPV -2589,000 R$ and B/C ratio 0.70 that is not feasible financially, but it may be said that it is possible to carry out if introduced low-interest fund and effective administration.

Table 29.1.4 Results of Cost-Benefit Analysis

A project	NPV (1,000 R$)	B/C ratio	FIRR
A: Basics case	-10,012	0	-
B: entering a building charges / the seminar participation fee collection	-9,067	0.09	-
C: It is mobilized all possible profit sources	-4,032	0.60	- 6.5%
D: Personnel expenses reduction by volunteers	-8,569	0	-
E: (B + C + D)	-2,589	0.70	2.7%

Table 29.1.5 Expense Advantage Calculation for Environment Center Alternative E

No.	Year	Alternative E				
		Cost			Revenue	Revenue - Cost
		Investment Cost	O&M Cost	Total Cost		
1	2006	0	0	0	0	0
2	2007	0	0	0	0	0
3	2008	143	0	143	0	-143
4	2009	143	0	143	0	-143
5	2010	2,972	0	2,972	0	-2,972
6	2011	5,507	0	5,507	0	-5,507
7	2012	0	1,007	1,007	1,544	537
8	2013	0	1,007	1,007	1,544	537
9	2014	0	1,007	1,007	1,544	537
10	2015	0	1,007	1,007	1,544	537
11	2016	0	1,007	1,007	1,544	537
12	2017	0	1,007	1,007	1,544	537
13	2018	0	1,007	1,007	1,544	537
14	2019	0	1,007	1,007	1,544	537
15	2020	0	1,007	1,007	1,544	537
16	2021	0	1,007	1,007	1,544	537
17	2022	0	1,007	1,007	1,544	537
18	2023	0	1,007	1,007	1,544	537
19	2024	0	1,007	1,007	1,544	537
20	2025	0	1,007	1,007	1,544	537
21	2026	0	1,007	1,007	1,544	537
22	2027	0	1,007	1,007	1,544	537
23	2028	0	1,007	1,007	1,544	537
24	2029	0	1,007	1,007	1,544	537
25	2030	0	1,007	1,007	1,544	537
26	2031	0	1,007	1,007	1,544	537
27	2032	0	1,007	1,007	1,544	537
28	2033	0	1,007	1,007	1,544	537

FIRR	2.7%
NPV	-R$ 2,589
B/C ratio	0.70

R$ 8,569	R$ 5,980

29.2 SABESP jurisdiction Projects

29.2.1 Cost Estimates of SABESP jurisdiction projects

Table 29.2.1 shows cost estimation of SABESP projects, that were mentioned in **Chapter 21** (Sewerage construction in the urban areas) and **Chapter 22** (Sewerage construction in the isolated communities).

Investment cost is accounted 147,585,000 R$ as total, that consists of 124,833,000 R$ (85%) for sewerage construction in the urban areas and 22,752,000 R$ (15%) for sewerage construction in the isolated communities.

As for operation and maintenance cost, sewerage construction in the isolated communities increase gradually after operation in 2013 as first year 822,000 R$. Sewerage construction in the urban areas r is 1,140,000 R$ every year.

(1) Sewerage construction in the urban areas

The investment cost is estimated in total at 124,833,000 R$. As for the breakdown, construction cost for Lot-1 54,571,000 R$ (44%), Lot-2 21,660,000 R$ (17%), Lot-3 37,215,000 R$ (30%), consulting fee 9,907,000 R$ (8%), and land cost 1,480,000 R$ (1%). (Refer to **Annex 29.2.1**).

O&M cost is 1,140,000 R$ every year; (refer to **Annex 29.2.3**).

(2) Sewerage construction in the isolated communities

The investment cost is estimated in total at 22,752,000 R$. As for the breakdown, Santa Cruz construction cost (including consulting fee, site expropriation cost) is 4,956,000 R$ (23%), and Riacho Grande construction cost (the same as above) is 17,796,000 R$ (77%) (Refer to **Annex 29.2.2**).

O&M cost increases gradually after operation in 2013, as first year 822,000 R$ (Refer to **Annex 29.2.4**).

Table 29.2.1 Cost Estimation of SABESP Jurisdiction Projects

	Total Cost	SABESP Self-fund	JBIC Yen Loan	JBICYen Loan （Yen Equiv.）
	1000R$	1000R$	1000R$	Million Yen
Two Project Total				
Investment Cost	147,585	33,809	113,776	5,929
O&M Cost per Year	1,962	1,962	0	0
Sewerage Construction in Urban Area				
Construction Cost Lot 1	54,571	13,643	40,928	2,133
Construction Cost Lot 2	21,660	5,415	16,245	847
Construction Cost Lot 3	37,215	9,304	27,911	1,454
Consulting Cost	9,907	0	9,907	516
Land Cost	1,480	1,480	0	0
Investment Cost	124,833	29,842	94,992	4,950
O&M Cost per Year	1,140	1,140	0	0
Sewearge Construction in Isolated Communities				
Santa Cruz / STP	3,400	537	2,863	149
SC/Pipeline	1,030	257	772	40
SC/Land Cost	216	54	162	8
SC/Consulting Cost	310	0	310	16
SC Sub-total	4,956	848	4,107	214
Rio Grand/STP	12,690	2,134	10,556	550
RG/Pipeline	3,942	986	2,957	154
RG/Land Cost	0	0	0	0
RG/Consulting Cost	1,164	0	1,164	61
RG Sub-total	17,796	3,120	14,677	765
Investment Cost Total	22,752	3,968	18,784	979
O&M Cost per Year(*)	822	822	0	0

Exchange Rate 52.11 Yen/R$

*The first year. Gradually increase due to swage volume increasing.

29.2.2 Funding plan of SABESP jurisdiction projects

SABESP as an executing agency has intention to use Yen loan (JBIC) besides self-fund. Yen loan is applied to only funds for investment cost except the land purchase and cannot apply operation and maintenance cost.

Although application of Yen loan is not decided, assuming the condition of Yen loan, finance source of the projects is sorted. When project cost was estimated, that was divided into Local Currency Potion and Foreign Currency Potion. The foreign currency potion assumed 100% JBIC fund and Local Currency Potion assumed self-fund of SABESP 25% and JBIC fund 75%.

The result of the above-mentioned journalizing work is summarized in **Table 29.2.2**.

Investment cost of two projects is 147,585,000 R$, and it is served 33,809,000 R$ (23%) by SABESP self-fund and 113,776,000 R$ (5,929,000,000 yen) (77%) by JBIC fund. O&M cost is funded by only self-fund of SABESP.

Table 29.2.2 SABESP Jurisdiction Business Fund Plan

	Total Cost	SABESP Self-fund	JBIC Yen Loan	JBIC Yen Loan (equiv. Yen)
	1000R $	1000R $	1000R $	Million Yen
Two project total				
Investment cost	147,585	33,809	113,776	5,929
O&M cost per year	1,962	1,962	0	0
Sewerage construction in the urban areas				
Construction cost Lot 1	54,571	13,643	40,928	2,133
Construction cost Lot 2	21,660	5,415	16,245	847
Construction cost Lot 3	37,215	9,304	27,911	1,454
Consulting fee	9,907	0	9,907	516
Land cost	1,480	1,480	0	0
Investment cost	124,833	29,842	94,992	4,950
O&M cost per year	1,140	1,140	0	0
Sewerage construction in the isolated communities				
Santa Cruz (SC)/ STP	3,400	537	2,863	149
SC/Pipeline	1,030	257	772	40
SC/Land cost	216	54	162	8
SC/Consulting fee	310	0	310	16
SC Sub-total	4,956	848	4,107	214
Riacho Grand (RG)/STP	12,690	2,134	10,556	550
RG/Pipeline	3,942	986	2,957	154
RG/Land Cost	0	0	0	0
RG/Consulting fee	1,164	0	1,164	61
RG Sub-total	17,796	3,120	14,677	765
Investment cost total	22,752	3,968	18,784	979
O&M cost per year(*)	822	822	0	0
Exchange rate	52.11	Yen/R$		
*The first year. Gradually increase due to swage volume increasing.				

29.2.3 Cost-Benefit Analysis

The sewer income is estimated with following calculation formula.

Income = (Design population) / (Population per household) x (Wastewater charge bill per household) x (Bill collection rate)

Design population

Future population for both sewerage projects in urban area and isolated communities is projected by the year of 2025 and constant after 2026.

Population per household

It is set at 5.1 people per household.

Wastewater charge bill per household

The category for class 21-30 L/ month of Residential/Normal is adopted. Now residents in SBC are applied special small sum bill as taking a step for shift, because sewerage business was transferred from SBC to SABESP in 2004. However in this study normal bill is applied to SBC citizen.

Bill collection rate

Detailed data of bill collection that shows person paying among users connected to the sewer is not clear. Using data as total, the bill collection rate that will be improved by environmental education is predicted.

Income (benefit) in the condition above mentioned is calculated (Detail is referred to **Annex 29.2.5** for sewerage construction in the urban areas, and **Annex 29.2.6** for sewerage construction in the isolated communities).

Table 29.2.2 shows the result of cost-benefit analysis of SABESP projects, assuming 2006 as the base year and project period for 25 years from 2008 as project start to 2033 and 12% as discount rate.

Table 29.2.3 Cost-Benefit Analysis for SABESP Jurisdiction Projects

A project	NPV (1000R$)	B/C ratio	FIRR
Sewerage construction in the urban areas	-34,334	0.45	2.6%
Sewerage construction in the isolated communities	-8,529	0.42	0.1%

Sewerage construction in the urban areas: Net present value (NPV) is a minus, and, cost coverage ratio (B/C ratio) is under 1, and financial internal rate of return (FIRR) is 2.6% that means not financially feasible, but exceeds an interest rate of Yen loan. It is necessary to make effort to increase incomes at a higher collection percentage than the assumed collection rate, and to reduce investment cost and O&M cost.

Sewerage construction in the isolated communities: Net present value (NPV) is a minus, and, cost coverage ratio (B/C ratio) is under 1, and financial internal rate of return (FIRR) is 0.1% that means worse than sewerage construction in the urban areas. It is necessary to make

effort to increase incomes at a higher collection percentage than the assumed collection rate, and to reduce investment cost and O&M cost.

Sensibility analysis is conducted based on base case as above mentioned.

Case B: Assumed to raise application rate and improve the collection rate,

Case C: 5% reduced in investment cost

Case D: 20% reduced in O&M cost

Case E: Case B + C + D at same time:

Sensitivity of an income is high both in sewerage construction in the urban areas and isolated communities. In other words, financial soundness of project is improved by income increasing by environmental educations.

Table 29.2.4 Sensitivity Analysis

Project	NPV (1000 R$)	B/C ratio	FIRR
[Sewerage construction in the urban areas]			
A: basics case	-34,334	0.45	2.6%
B: collection rate 15% up	-28,749	0.54	4.5%
C: 5% reduced investment cost	-31,469	0.47	3.0%
D: O&M cost 20% down	-33,342	0.46	2.9%
E: (B + C + D)	-27,751	0.55	4.8%
[Sewerage construction in the isolated communities]			
A basics case	-8,529	0.42	0.1%
B: 1.2 times rate of normal local	-7,307	0.50	2.5%
C: 5% reduced investment cost	-7,945	0.43	0.5%
D: O&M cost 20% down	-7,939	0.43	1.3%
E: (B + C + D)	-6,133	0.54	3.9%

Table 29.2.5 Cost-Benefit Analysis for Sewerage Construction in the Urban Areas

Base Case (1000R$)

No.	Year	Cost			Revenue	Revenue - Cost
		Investment Cost	O&M Cost	Total Cost		
1	2006	0	0	0	0	0
2	2007	0	0	0	0	0
3	2008	0	0	0	0	0
4	2009	3,706	0	3,706	0	-3,706
5	2010	12,327	0	12,327	0	-12,327
6	2011	26,198	0	26,198	0	-26,198
7	2012	44,178	0	44,178	0	-44,178
8	2013	21,097	304	21,401	3,895	-17,506
9	2014	17,119	313	17,432	4,043	-13,389
10	2015	0	1,671	1,671	7,565	5,894
11	2016	0	1,687	1,687	7,828	6,141
12	2017	0	1,704	1,704	8,097	6,393
13	2018	0	1,721	1,721	8,371	6,651
14	2019	0	1,737	1,737	8,651	6,914
15	2020	0	1,753	1,753	9,443	7,690
16	2021	0	1,769	1,769	9,742	7,973
17	2022	0	1,784	1,784	10,046	8,262
18	2023	0	1,799	1,799	10,356	8,557
19	2024	0	1,814	1,814	10,671	8,857
20	2025	0	1,830	1,830	10,790	8,960
21	2026	0	1,830	1,830	10,790	8,960
22	2027	0	1,830	1,830	10,790	8,960
23	2028	0	1,830	1,830	10,790	8,960
24	2029	0	1,830	1,830	10,790	8,960
25	2030	0	1,830	1,830	10,790	8,960
26	2031	0	1,830	1,830	10,790	8,960
27	2032	0	1,830	1,830	10,790	8,960
28	2033	0	1,830	1,830	10,790	8,960
29	2034	0	1,830	1,830	10,790	8,960

FIRR	2.6%
NPV	-34,334
B/C ratio	0.45

62,260	27,926

Table 29.2.6 Cost-Benefit Analysis for Sewerage Construction in the Isolated Communities

(1000R$)

No.	Year	Cost			Revenue	Revenue - Cost
		Investment Cost	O&M Cost	Total Cost		
1	2006	0	0	0	0	0
2	2007	0	0	0	0	0
3	2008	295	0	295	0	-295
4	2009	295	0	295	0	-295
5	2010	7,248	0	7,248	0	-7,248
6	2011	7,882	0	7,882	0	-7,882
7	2012	7,032	0	7,032	0	-7,032
8	2013	0	822	822	1,347	526
9	2014	0	830	830	1,400	570
10	2015	0	837	837	1,557	720
11	2016	0	846	846	1,614	769
12	2017	0	854	854	1,671	817
13	2018	0	859	859	1,728	869
14	2019	0	867	867	1,785	918
15	2020	0	872	872	1,947	1,075
16	2021	0	880	880	2,010	1,130
17	2022	0	888	888	2,073	1,186
18	2023	0	896	896	2,138	1,243
19	2024	0	904	904	2,205	1,301
20	2025	0	908	908	2,236	1,329
21	2026	0	908	908	2,236	1,329
22	2027	0	908	908	2,236	1,329
23	2028	0	908	908	2,236	1,329
24	2029	0	908	908	2,236	1,329
25	2030	0	908	908	2,236	1,329
26	2031	0	908	908	2,236	1,329
27	2032	0	908	908	2,236	1,329
28	2033	0	908	908	2,236	1,329

FIRR	0.1%
NPV	-8,529
B/C ratio	0.42

14,637	6,108

Chapter 30

PROJECT EVALUATION

30. PROJECT EVALUATION

In the Study on the Environment Improvement in the catchment area of the Lake Billings, the following eight projects are selected as the priority projects

(1) Projects to be undertaken by the Municipality of Sao Bernardo do Campo

1) Construction of the Environmental Centre
2) Permeable pavement
3) Park provision
4) Remediation of the former Alvarenga solid waste dumping site
5) Installation of a pilot plant using aquatic plants

(2) Projects to be undertaken by the SABESP

1) Sewerage construction in the urban areas
2) Sewerage construction in the isolated communities

Out of the above, the Environmental Centre is an integration of the Environmental Centre for Experimental Study and the Water Quality Management Centre which were proposed in the Master Plan, but combined through a discussion with the Department of Housing and Environment (SHAMA) of the Municipality, since they are planned in adjoining in the municipality-owned Estoril Park.

The priority projects are evaluated from the financial, socio-economic, technical, organizational and institutional and environmental aspects below.

30.1 Financial

(1) Projects to be undertaken by the Municipality of Sao Bernardo do Campo

The Municipality of Sao Bernardo do Campo does not assume any income from five projects. Investment cost of five projects is 52,913,000 R$, and it is served 13,550,000 R$ (26%) by SBC self-fund and 39,363,000 R$ (2,050,000,000 yen) (74%) by JBIC fund. O&M cost 1,619,000 R$ per year is funded by only self-fund of SBC. However, the Municipality has credibility of direct loan based on financial responsibility law according to financial data in 2004. In other words, a basic condition to request Yen loan satisfies it.

The Environmental Centre has a possibility to get an income. When considering this, it is not feasible financially, but it may be said that it is possible to carry out if introduced low-interest fund and effective administration.

(2) Projects to be undertaken by the SABESP

Sewerage construction in the urban areas: Net present value (NPV) is a minus, and, cost coverage ratio (B/C Ratio) is under 1, and financial internal rate of return (FIRR) is 2.6% that means not financially feasible, but exceeds an interest rate of Yen loan. It is necessary to make effort to increase incomes at a higher collection percentage than the assumed collection rate, reduce investment cost and O&M cost.

Sewerage construction in the isolated communities: Net present value (NPV) is a minus, and, cost coverage ratio (B/C Ratio) is under 1, and financial internal rate of return (FIRR) is 0.1% that means worse than sewerage construction in the urban areas. It is necessary to make effort to increase incomes at a higher collection percentage than the assumed collection rate, and to reduce investment cost and O&M cost.

30.2 Socio-economic

It should be noted that the goal of this project is to protect the Lake Billings from further water quality deterioration, and to secure the living of the people in the Greater Sao Paulo Region who use the lake as a drinking water source through improvement in water quality. At present, the SABESP takes water of 4.7 m^3/sec from the Rio Grande Arm for water supply to 1.60 million people mainly in the ABC Region of the Greater Sao Paulo, and water of 4.0 m^3/sec from the Taquacetuba Arm for 1.14 million people. The water taken from the Taquacetuba Arm is pumped up to the Lake Guarapiranga from which the Alto da Vista Water Treatment Plant takes water of 13.38 m3/sec including 4.0 m^3/sec fro the above Taquacetuba Arm for water supply to 3.60 million people. Accordingly, the Lake Billings including the Rio Grande Arm is the water source for 2.68 [= 1.60 + 3.60 x (4.0/13.38)] million people. To respond an increase of water demand, the SABESP has an expansion plan in which the Rio Pequeno Arm is separated completely from the Lake Billings by the construction of an embankment similar to the Rio Grande Arm and connected by a tunnel to the Rio Grande Arm as well as the augmentation of the Rio Grande Water Treatment Plant. The importance of the Lake Billings as a water source has been even greater now.

In addition to the obvious benefit such as the protection of rich natural environment, supply of safe water and provision of the rest place towards “Coexistence Harmonized with Water, Being and Green”, the Project brings the following socio-economic benefit:

	Executing agency	
	SBC	SABESP
• Increase in employment opportunity	Yes	Yes
• Reduction of treatment cost	No	Yes
• Cost reduction for removal of algae and aquatic plants	No	Yes
• Raise in land cost	Yes	Yes

30.3 Technical

(1) Projects to be undertaken by the Municipality of Sao Bernardo do Campo

As the biggest pollutant source in the basin of the Lake Billings is domestic wastewater which is left to the SABESP responsible for the sewerage construction, the Municipality undertakes the project putting an emphasis on the restoration of water quantity, strengthening of combination among water, being and green, and the study and research. The Municipality has much experience in the similar works for permeable pavement, construction of the Alvarenga Park, remediation of the former Alvarenga solid waste dumping site, and the construction of the Environmental Center, without any problem in the construction stage

For the installation of a pilot plant using aquatic plants, it is better to collect overseas and domestic knowledge, and design and construct the facility with scrupulous care. Attention be paid for that aquatic plants is not scattered and lost under construction.

(2) Projects to be undertaken by the SABESP

For domestic wastewater that is currently discharged into the Lake Billings without treatment except for that in the very limited area and give a great affect on water quality of the Lake Billings, the optimum system solution is formulated, taking into account the consistency with the relevant and superior plans, dividing the study area into the urban areas, isolated communities and others, studying a various alternatives including wastewater treatment inside and outside the basin (wastewater conveyance to the existing ABC WWTP in the Tamanuduatei River basin), arrangement of sewerage facilities, construction method and so on.

For the sewerage construction in the urban areas, the plan to convey wastewater in the basin to the existing ABC WWTP is adopted, which makes a runoff load into the lake zero.

For the sewerage construction in the isolated communities, the issues on wastewater conveyance outside the basin, independent treatment at each community or some integrated communities, on-site treatment by septic tanks are studied and the plan composed of reconstruction of the Riacho Grande WWTP with an expansion of service area and construction of the Santa Cruz WWTP is adopted. Through the study on the water quality requirement for the Lake Billings, costs for construction and O&M, easiness in O&M, etc., the oxidation ditch process with phosphorous

removal is finally selected.

The attainment status of the water quality conservation targets through measures the sewerage construction in both the urban area and isolated communities was verified using the mathematical model. The results shows that the parameters of BOD_5, DO and NH_4-N meet the 2025 water quality conservation targets for Class 1 but Chlorophyll-a and TP does no meet even that for Class 2, although they have a possibility to clear it in case of no pumping of the Tiete River water to the Lake Billing. In the Rio Grande Arm, the parameters of BOD_5, DO, NH_4-N and TP meet the 2025 water quality conservation targets for Class 1 and Chlorophyll-a that for Class 2.

Therefore, the projects proposed in the present study is technically feasible.

30.4 Organizational and Institutional

(1) Projects to be undertaken by the Municipality of Sao Bernardo do Campo

The Municipality of Sao Bernardo do Campo has already sufficient experience and staff for the operation and maintenance of permeable pavement, construction of the Alvarenga Park and remediation of the former Alvarenga solid waste dumping site, while for the management of the Environmental Centre and the study of lake purification using aquatic plants were new experiences. The many people have concern about the Lake Billings, as represented by “Seminario Billings 2002” and it is considered to be possible to secure the human resources, if recruiting extensively, and to get the cooperation of volunteers. For the construction and management of the Environmental Centre as the base of activities for the basin environment improvement of the Lake Billings, it is recommended to gather the wisdom of many people widely as well as the recruitment of professional staff for the study and research.

(2) Projects to be undertaken by the SABESP

The sewerage construction is undertaken by the SABESP, a ware supply and sewerage service provider, of which the State Government of Sao Paulo is the biggest stockholder. The SABESP has been managed efficiently in spite of its great scale and its operation and maintenance is in an almost equivalent level to those of Japan and Korea. Therefore, there is no organizational and institutional problem.

30.5 Environmental

The Study aims at basin environment improvement of the Lake Billings and the implementation of the projects including their construction works is undertaken by the administrative side mainly. But for the activities of basin environment improvement, the cooperation of all stakeholders such as the people, NGOs, schools etc. including the administrative side is proposed in which it goes without saying that attention is paid for to minimize an affect on the environment.

For the projectes proposed in this Study, the screening was conducted in accordance with the Guidelines for Environmental and Social Considerations of JICA, taking into account the environmental impact assessment system currently practiced in Brazil. The results shows that there is no Category A project that gives severe affect on the environment and society but almost projects are regarded as Category B which gives less affect than Category A.

(1) Projects to be undertaken by the Municipality of Sao Bernardo do Campo

The remediation of the former Alvarenga solid waste dumping site requires consideration for slope collapse under construction.

For the installation of a pilot plant for lake purification using aquatic plants, the necessity to get a consent of the EMAE as an owner of the Lake Billings, breeding possibility of dengue-transmitting mosquito at a pilot plant, scattering and growing possibility of water hyacinth to be used at a pilot plant, and reaction of the CETESB for the above issues have not been unknown and need confirmation thereon in the future.

(2) Projects to be undertaken by the SABESP

The installation of the Couros Trunk Sewer along the Couros River avoiding the existing underground utilities and the special construction method adopted in order to detour the existing storm water retarding pond and to change the route from along the Couros River to on the existing road are the most careful portion in the construction work. Other works such as pipe installation and construction of pumping stations are in a category of ordinary works.

As the present Riacho Grande WWTP has been operated using one module out of two, it is possible to reconstruct it without a stoppage of its operation.

30.6 Overall Evaluation

Each project proposed has its own problem individually viewing from the financial, socio-economic, technical, operational and institutional and environmental aspects, but they are not fatal in nature. Therefore, the project proposed are justifiable for implementation, if they will be constructed with an attention on the matter pointed out mentioned above.

Chapter 31

SUPPORT FOR EIA

31. SUPPORT FOR EIA

31.1 Requirement on Environmental Licenses and Its Details for Priority Projects

31.1.1 Outlines of Priority Projects

The proposed priority projects are planned to be developed in SBC city, and their outlines and locations are shown in **Table 31.1.1** and **Figure 31.1.1**, respectively.

Table 31.1.1 Outlines of Priority Projects

Name of Project	Location	Project Purpose / Facility / Scale
Sewage Treatment Project in Urban Areas	Northen Coast Areas of Billings Lake: Alvarenga / Labras	Transport of sewage to existing ABC treatment plant: Sewer pipe: 4.4km, Semi-sewer pipe: 4.4km（Φ400～1,000mm）, 2.3km（Φ250～900mm）, 21.8km（Φ250～500mm）, Areal development（Φ200～600mm）、Main pump station：3 locations
Sewage Treatment Project in Isolated Communities	Riacho Grande and Santa Cruz district, southern coast of Billings lake	Expansion of existing sewage treatment plant (Riacho Grande), new development of sewage treatment plant (Santa Cruz) 1) Riacho Grande Planned population for treatment: 38,200 • Planned treatment capacity: 7,330m^3/day • Treatment method: Oxidation ditch process + Flocculant addition / phosphorus removal process • Sludge treatment: Transport to existing ABC treatment plant after dewatering 2) Santa Cruz • Planned population for treatment: 4,000 • Planned treatment capacity: 780m3/day • Treatment method: Oxidation ditch process + Flocculant addition / phosphorus removal process • Sludge treatment: Transport to Riacho Grande treatment plant by vacuum car after reduction of volume
Permeable Pavement Project	Northern coast of Billings lake (Along Immigrantes highway, Alvarenga district), Southern coast of Billings lake (Santa Cruz)	• Rain runoff prevention, groundwater recharge • Extension of length of permeable pavement: 29.2km • Drain box (chamber): 202 • Manhole: 24 • Distribution pipe: 2.5km • Distribution pipe in housing lot: 12.4km
Public park / green space development	Adjacent area of Alvarenga river, Alvarenga district in Northern coast of Billings lake	• Rain runoff prevention, groundwater recharge • Administrative use road, planting work, lighting works • Area: 2.1ha
Remediation project of former Alvarenga open dumping site	Alvarenga district in Northern coast of Billings lake	• Remediation of hazardous risk (treatment of leachate, slope protection, etc.) • Slope protection, embankment, drainage, reservoir tank of leachate, administration use road, fence, guardhouse, planting works, lighting • Leachate treatment: Transport to ABC treatment plant after reserve at reservoir tank • Project area: 25ha
Pilot lake purification project by using water plant	Billings lake water area (Water area in front of Pinheirnio treatment plant)	• Study on advantageous and disadvantage effect for water quality purification by using natural purification function of water plant, preparation of guideline of its future application • Major facilities: Steel deck (width: 2m, length: 150m), steel slab, floating fence
Installation of environmental protection center	Inside Estoril park	• Facility for environmental education • Facility items: Exhibition hall, learning room, reference room, dining room, residence rooms for trainees, landing pier, water quality laboratory, research room, administration office • Equipment: Water quality analyzer, ships for lake cruising for education, bus, administration viehcle • Required land: 1ha • Building area: 2500m2 • Total floor area: 2700m2

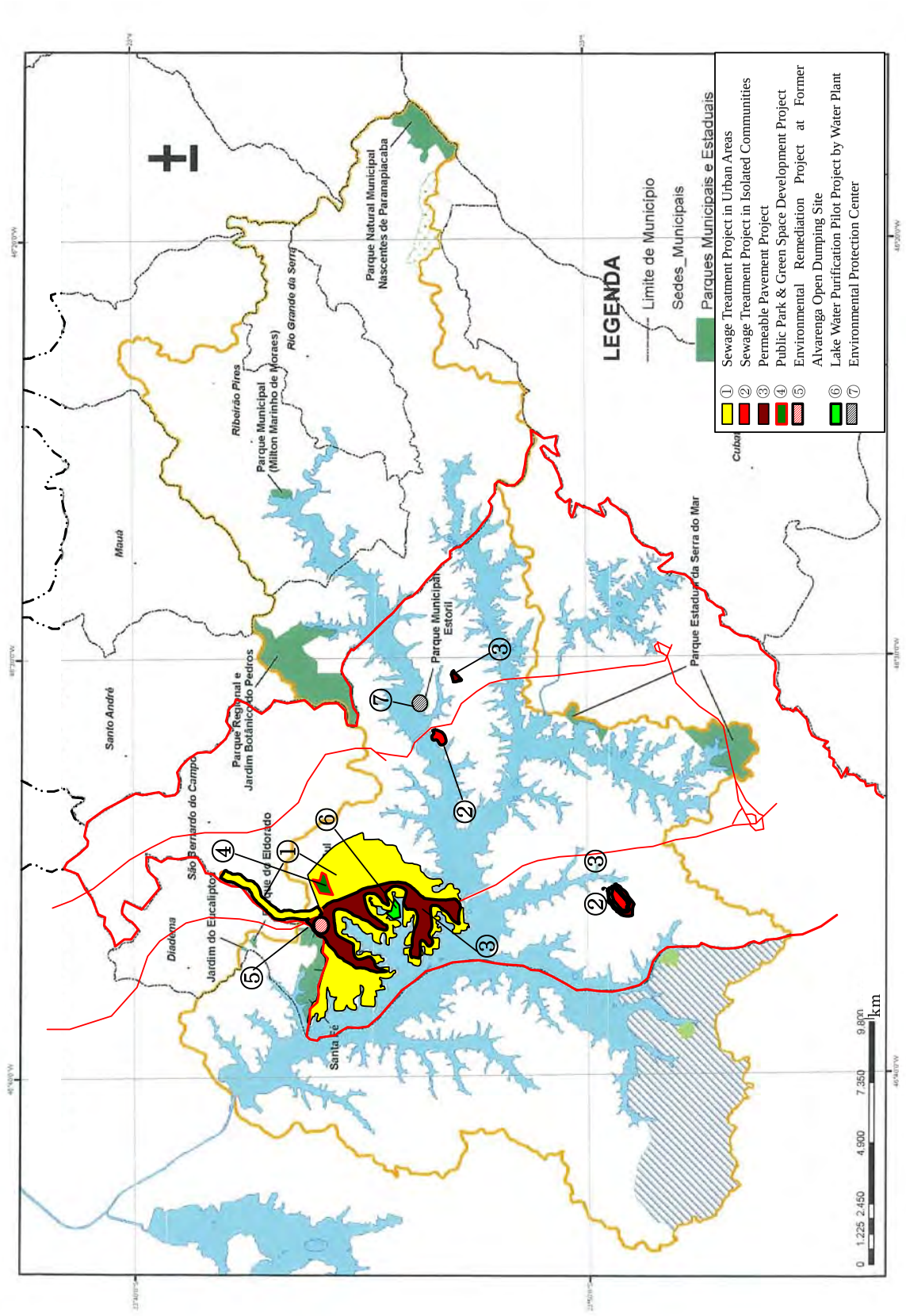


Figure 31.1.1 Outlines and locations of the proposed priority projects

31.1.2 Necessity on Environmental Licenses for Priority Projects

The necessity on environmental licenses based on Sao Paulo State environmental impact assessment legislation and other institutional requirements related to the proposed priority projects was examined through the confirmation with DAIA of SMA and the Division of Environmental License and Evaluation (Departamento de Licenciamento e Avaliacao Ambiental) of SHAMA in SBC. **Table 31.1.2** shows the results of above confirmation.

Table 31.1.2 Necessity on Environmental Licenses for Priority Projects

Name of Project	Necessity on EIA/RIMA	Requirement on Procedures other than EIA/RIMA
Sewage Treatment Project in Urban Areas	EIA/RIMA is not necessary.	Procedure following upon the application for LI is necessary. Project proponent should submit necessary documents to CETESB, DUSM and DEPRAM who are Sao Paulo state government relevant authorities.
Sewage Treatment Project in Isolated Communities	EIA/RIMA is not necessary.	Project proponent should submit RAP to DAIA or CETESB. DAIA or CETESB shall examine for its approval and licenses for LP, LI and LO.
Permeable Pavement Project	EIA/RIMA is not necessary.	Project proponent should give notice to DUSM and submit necessary documents.
Public Parks and Green Space Development Project	EIA/RIMA is not necessary.	Project proponent should give notice to DUSM and submit necessary documents.
Environmental Remediation Project of Former Alvarenga Open Dumping Site	EIA/RIMA is not necessary.	The project site is designated as contaminated area by CETESB and project proponent should require the survey / study which should follow the CETESB's management regulation or the environmental remediation of the contaminated areas.
Pilot Project for Water Purification using Water Plants	EIA/RIMA is not necessary.	The proposed project should require LP, LI and LO. Furthermore, the application procedure with the relevant administration authorities including EMAE is necessary.
Installation of Environmental Protection Center	EIA/RIMA is not necessary.	Project proponent should give notice to DUSM and submit necessary documents.

注）
1. LP：Licenca Previa (Preliminbary Licence)
2. LI：Licenca de Instalaçao (Installation Licence)
3. LO：Licenca de Operaçao (Operation Licence)
4. DUSM：Departamento de Uso do Solo Metropolitana（Metropolitan Land Use Department）
5. RAP: Relatorio Ambiental Preliminar (Preliminary Environmental Report）

As shown in **Table 31.1.2**, the proposed priority projects do not destruct environment severely and they basically aim at the environmental improvement of the lake basin. Accordingly, they do not require preparation of EIA/RIMA. However, the proposed priority projects should require other procedures separately in accordance with the individual requirement by submitting necessary documents to the reviewing authorities.

The detailed procedure in case of above priority projects is shown as follows.

Sewage Treatment Project in Urban Areas:

According to DAIA, the proposed project is regarded as a complementary project of Tiete project (Projeto Tiete) which is being implemented as a metropolitan sewage treatment project by SABESP. Its master plan (Plano Diretor) study had already been prepared in 1980', and its EIA/RIMA study was conducted in 1989 and LP was already granted for the project in 1991. The proposed project is basically to transport the sewage of the planned areas to existing ABC treatment plant and it can commence its procedure at LI without preparation of EIA/RIMA and obtaining LP.

Sewage Treatment Project in Isolated Communities:

The proposed project is not connected with existing sewerage networks and it conducts the sewage treatment in each community units. In that case, the proposed project does not require the preparation of EIA/RIMA in accordance with SMA Resolution 42/94 (Resolucao SMA No.42-29/12/94) and can only submit the preliminary environmental report（RAP: Relatorio Ambiental Preliminar). In addition, according to SMA Resolution 19/96, project proponent should submit RAP to DAIA and obtain LP, LI and LO from DAIA for the case of the planned population exceeding 30,000, while he shhould submit RAP to CETESB and obtain LI/LO from CETESB in case of the planned population below 30,000. In case of the proposed project in Santa Cruz where the planned population is approximately 4,000 or below 30,000, the project proponent should submit RAP to CETESB and obtain LI/LO from CETESB, while the project proponent should submit RAP to DAIA and obtain LP, LI and LO from DAIA for the case of Riacho Grande whose planned population is over 30,000.

Permeable Pavement Project:

The proposed project does not require the preparation of EIA/RIMA. However, since the project is located in the water resources protection area (APM: Area de Protecao aos Manaciais), project proponent should apply for DUSM of Sao Paulo state government, submit the project outline documents (e.g. schematic project map, project purpose and project outlines, etc.) and obtain the project approval from DUSM.

Public Park / Green Space Development Project:

The proposed project does not require the preparation of EIA/RIMA in the same manner of above Permeable Pavement Project. However, since the project site is located in APM, a project proponent shall apply for DUSM of Sao Paulo state government, submit the project outline documents (e.g. schematic project map, project purpose and project outlines, etc.) and obtain the project approval from DUSM.

Environmental Remediation Project at Former Alvarenga Open Dumping Site:

CETESB released the list on the contaminated areas inside Sao Paulo state in May, 2002, and 1,644 sites have been registered as contaminated areas at the year of May 2006. The proposed project site is designated as one of above registered contaminated areas and classified as the category which should require the remediation process (Processo de recuperação de áreas contaminadas). In case of its implementation, proposed project should conduct the survey / study which is based on the management manual of the contaminated areas, and shall obtain the project approval from CETESB.

Pilot Project for Water Purification by using Water Plants:

The proposed project is located in the permanent conservation area (APP: Area de Preservacao Permanente) in accordance with the federal law of 4,771/65, and facility development is not allowed in principle. However, a project is allowed by obtaining LP, LI and LO if the main purpose of the project is a study or investigation for the water quality improvement of Billings Lake. The proposed project also should require the application for the project approval from EMAE of the property management agency the since the project is planned in the lake water area. In addition, the environmental license for treatment, transport and final disposal of solid wastes will be required since the proposed project will generate the treated wastes of water plants at operation stage.

Environmental Protection Center Development Project:

In the same manner of above Permeable Pavement Project, project proponent should apply for project approval with above DUSM in Sao Paulo state by submitting project plans (e.g. project-related drawings, project purpose and project outlines, etc.). The proposed project includes a landing bridge for the cruising ship for the onsite learning, when considering the situation that the proposed project is located in APP based on above federal law of 4,771/65, a project in above APP area cannot be developed in principle. However, such project can be implemented when a project proponent prepare the documents which the project works do not cause any erosion and he can obtain the approval for its implementation from DUSM.

31.1.3 Details of Requirement on Environmental License

The details of requirement on environmental license for priority projects are shown as follows.

Sewage Treatment Project in Urban Areas:

The proposed project needs to obtain LI and the following requirement should be verified.

- Site condition of project site
- Public buried infrastructure (utilities)
- Soil condition such as backfill and embankment if necessary
- Vegetation condition at project site

The following documents should be prepared at each reviewing authority for above verification.

- CETESB: Project outline document (MCE: Memorial de Caracterizacao do Empreendimento)
- DUSM: Project impact report on the water resources preservation area (Relatorio das Areas de Intervencao em Area de Protecao aos Manaciais)
- DEPRAM (Departamento Estadual de Protecao dos Recursos Naturais): Report on logging plan of vegetation and trees and the impact on its impact (Supressao de Vegetacao)

Sewage Treatment Project in Isolated Communities:

RAP should be prepared after studying the following items based on NTS062 which is SABESP's technical standards that specify the requirement of major environmental conservation.

- Land acquisition area
- Necessity on resettlement
- Dispute on land use and water use
- Change on water balance
- Impact to be caused by water discharge
- Confirmation on whether the effluent exceeds legal effluent standards
- Vegetation restoration to be caused by the project implementation
- Compliance with the federal, state and municipal legislation / institution
- Impact on environmental conservation area
- Partnership with local communities

- Approval for land use for borrow area and spoil bank
- Impact on existing infrastructure
- Generation of odor and noise

Permeable Pavement Project:

A project proponent should apply for project approval with DUSM by submitting project outline documents (e.g. schematic project map, project purpose and project outlines, etc.).

Public Park / Green Space Development Project:

In the same manner of Permeable Pavement Project, project proponent should apply for project approval with DUSM by submitting project outline documents (e.g. schematic project map, project purpose and project outlines, etc.).

Environmental Remediation Project at Former Alvarenga Open Dumping Site:

The proposed project, which is designated as one of CETESB's lists of contaminated areas, should require the survey, study, facility development and monitoring for the remediation process as shown in **Figure 31.1.2**.

- Detailed study (Acquisition of quantitative data on contamination level, size of affected area, contaminated substances and contamination concentration, etc.)
- Risk evaluation (Quantitative risk evaluation on the impact on human body, ecosystem, public infrastructure and crops)
- Study / Survey for remediation plan (Selection of ready-made technologies and their composite technologies)
- Establishment of remediation plan
- Implementation of remediation (Remediation of contaminated area)
- Monitoring (Implementation of monitoring based on environmental management legislation)

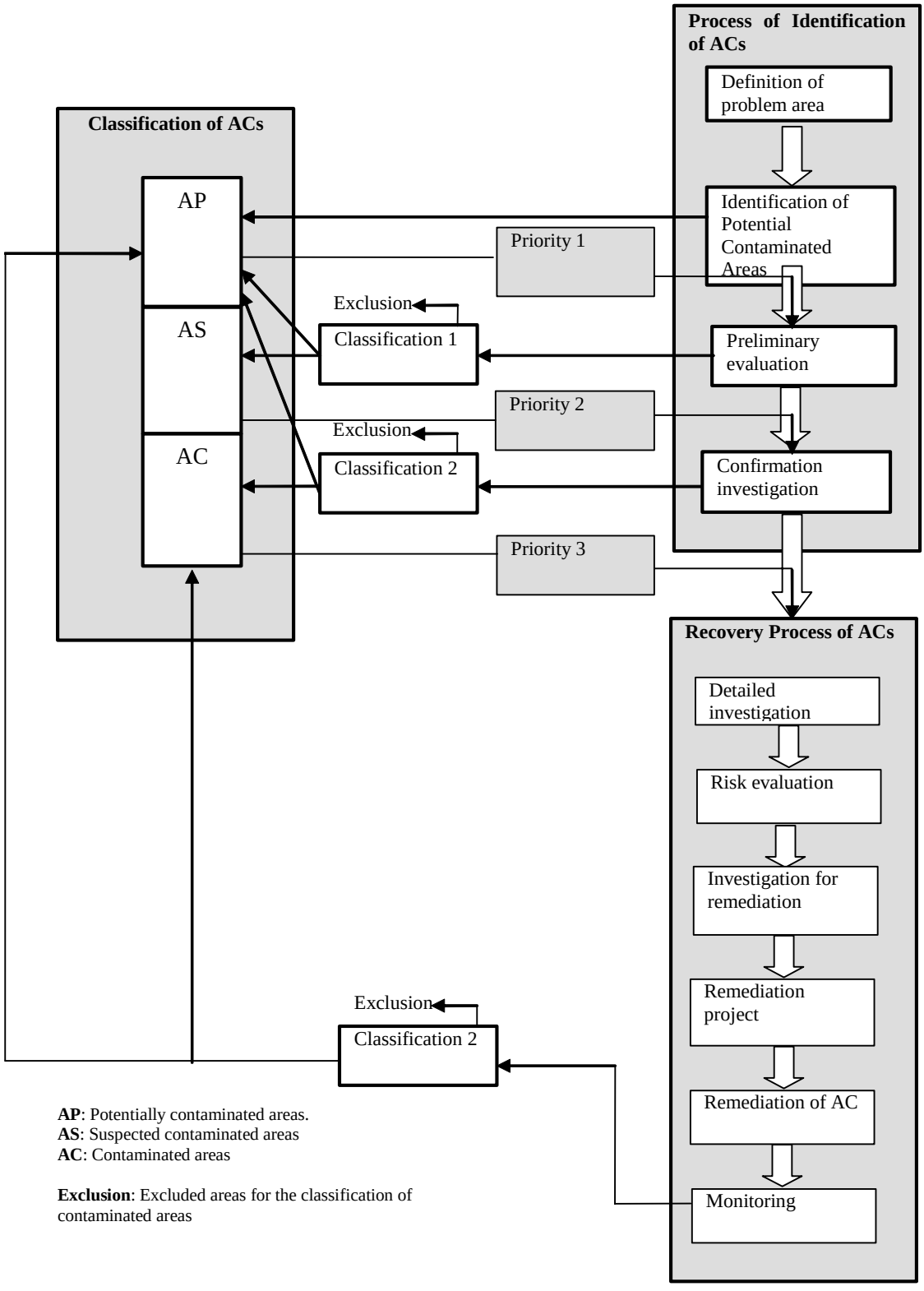


Figure 31.1.2 Remediation of Process Flow Contaminated Areas

Pilot Project for Water Purification using Water Plants:

The details of actual procedures and requirement on necessary documents will be decided when project proponent has a conference with clearing authorities (e.g. SMA, etc.) after the project description is fully decided.

Environmental Protection Center Development Project

As mentioned before, project proponent should apply for project approval with DUSM by submitting project outline documents (e.g. schematic project map, project purpose and project outlines, etc.). In addition, the project proponent should prepare the documents which reveal that the proposed project aims at environmental improvement and does not cause erosion at lake coasts.

31.2 Scoping on Priority Projects

31.2.1 Possible Environmental and Social Impact caused by Priority Projects

The environmental and social impacts for the priority projects are estimated as shown in **Table 31.2.1** which shows the impact level not more significant than category A. The Environmental Center project, which will not cause significant impact from IEE studies, was excluded for the scoping study.

Table 31.2.1 Possible Environmental and Social Impact caused by Priority Projects

No.	Name of Project	Possible Environmental and Social Impact		
		Before Construction	During Construction	During Operation
1	Sewage Treatment Project in Urban Areas（Alternative 1）	• Resettlement / Land Issue	• Traffic / Public Infrastructure • Hazard (Accidents caused by Construction works)	• Local economy • Noise
2	Sewage Treatment Project in Isolated Communities	• Land Issue	• Hazard (Accidents caused by Construction works)	• Local economy • Solid waste • Odor
3	Permeable Pavement Project		• Traffic / Public Infrastructure • Solid waste	
4	Public Park / Green Space Development Project	• Land Issue		
5	Environmental Remediation Project of Former Alvarenga Open Dumping Site	• Resettlement / Land Issue	• Hazard (Accidents caused by Construction works)	• Hazard
6	Pilot Project for Water Purification using Water Plants	• Right of use of water area		• Public health • Solid waste • Flora and fauna • Water pollution • Odor

(1) Sewage Treatment Project in Urban Areas

1) Resettlement / Land Issue

Alternative 1 was adopted as a priority project for the sewage treatment project in urban areas. In this case, resettlement and land issue due to land acquisition are as shown in **Figure 31.2.1** and **Table 31.2.2**. Resettlement is anticipated at A1, A2 and A5 in **Figure 31.2.1**, and land acquisition of total area is also anticipated at A2 and land acquisition for its partial land use is anticipated at A3 and A4. Land acquisition is required at A6 to A8 for the project sites of pump stations.

Table 31.2.2 Possible Resettlement and Land Acquisition to be caused by Sewage Treatment Project in Urban Areas

Symbol	Proposed Facility	Possible Impact	Disturbance Situation
A1	Sewer Pipe	Resettlement / Land Issue	The proposed project crosses a empty land, a factory area, private houses (2 houses) and parking areas. Resettlement is estimated for the private houses, and land acquisition (acquisition of use of partial land, or, acquisition of total land) is estimated for the empty land, factory area.
A2	Sewer Pipe	Resettlement	The proposed project crosses private houses (3 houses), and it requires resettlement.
A3	Sewer Pipe	Land issue (Use of partial land)	The proposed project partially crosses private parking areas.
A4	Sewer Pipe	Land issue (Use of partial land)	The proposed project partially crosses private factory areas.
A5	Sewer Pipe (Partly, river improvement)	Resettlement / Land Issue	The proposed project partially crosses private houses, dry fields and private factory areas.
A6	Pump station	Land issue (Land acquisition)	The project site currently includes no houses, and it requires land acquisition due to its private land.
A7	Pump station	Land issue (Land acquisition)	The project site currently includes no houses, and it requires land acquisition due to its private land.
A8	Pump station	Land issue (Land acquisition)	The project site currently includes no houses, and it requires land acquisition due to its private land.

In addition, SBC city should conduct urban upgrading process toward normalization / legitimization at the areas of A9 to A12 which are not directly affected by the proposed project. At above urban upgrading process by SBC city, some resettlement is anticipated.

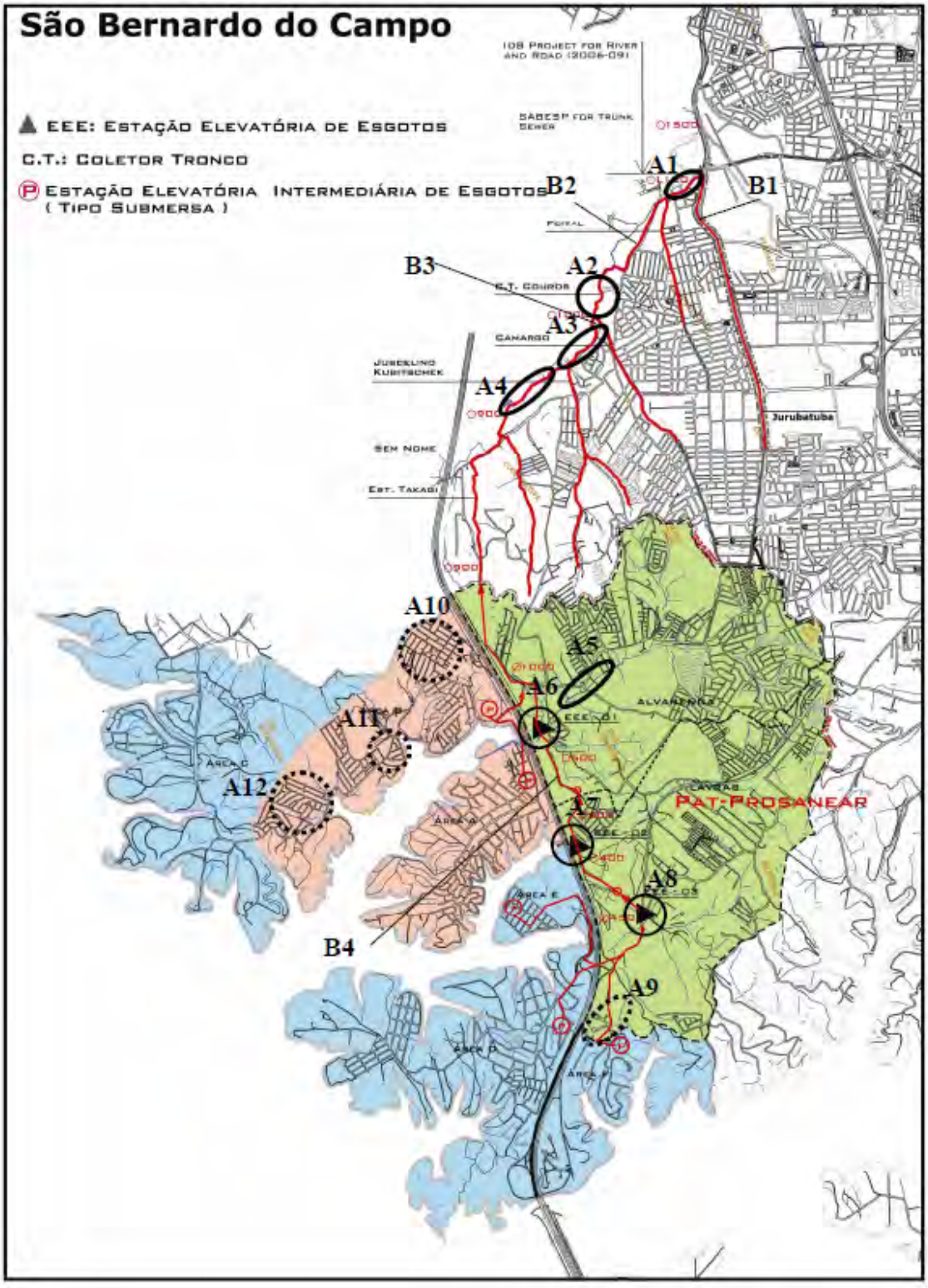


Figure 31.2.1 Location Map of Possible Resettlement and Land Issues

2) Economy

The proposed project which plans to transport and treatment of the planned sewage, will impose the sewage treatment tariff on the target beneficiaries. From the results of the public awareness survey, 60 % of the lake basin residents has shown negative attitude toward the additional tariff collection. This will cause some negative impact on the household economy of the basin residents from above survey results and the comparatively low-income situation of the basin residents.

3) Traffic / Public Infrastructure

The proposed sewer lines will disturb the surrounding traffic since their proposed projects are planned in existing road areas. **Table 31.2.3** and **Figure 31.2.1** (which has already been presented) show the possible roads which may be affected by the proposed project. The proposed project may also disturb the public infrastructure such as buried gas pipes, water pipes and telephone lines. The safety control measures should be strictly adopted for the construction works at B1 in **Table 31.2.3** which has the largest traffic volume.

Table 31.2.3 Possible Roads to be affected by Proposed Project

Symbol in Figure 31.2.1	Planned facility	Name of Road to be affected	Existing Traffic Volume[1)]
B1	Sewer line	Avenida Robert Kennedy	3,943 vehicle/day
B2	Sewer line	Avenida Humberto de Alencar Castelo Branco	2,770 vehicle/day
B3	Sewer line	Avenida Juscelino Kubitischek	2,095 vehicle/day
B4	Sewer line	Estrada Samuel Aizemberg	1,100 vehicle/day

Note)
1. By the interview with SBC city (August, 2006)

4) Hazard (Accident during Construction)

The proposed project may cause occupational and traffic accidents by taking its estimated construction works of the jacking method and open excavation at road areas into consideration. The planned jacking method is to install the pipe lines at the underground by excavating the planned position by a tunneling machine from a starting shaft by utilizing the counter force from the shaft and to connect the following jacking pipe. Above method is different from those of open excavation which can be controlled by human visual check, it requires the advanced and specialized construction technique in addition to normal construction technique in order to carry out the construction works in appropriate and safe manners. The proposed project may cause serious social accidents such as not only the generation of operational accidents at construction work place but also the damage to the surrounding houses, the damage to the existing underground utilities (e.g. gas pipes, water pipes, telecommunication pipes, etc.) or the road cave-in, if the appropriate judgment is not conducted by a contractor.

5) Noise

The operation of the proposed pump stations may cause noise. **Table 31.2.4** shows the surrounding environment of the proposed three pump stations as already shown in **Figure 31.2.1**. The noise impact at A7 (EEE-02) in **Table 31.2.4** is estimated to be largest among the proposed project sites.

Table 31.2.4 Surrounding Environment of Proposed Pump Stations

Symbol in Figure 31.2.1	Planned Facility	Surrounding Environment	Estimated Impact level
A6	Pump Station （EEE-01）	The project site is closed to Immigrantes Highway and can view their running vehicles and several housings.	The noise impact level is estimated as medium level between those of A7 and A8 since the proposed project is affected by the running vehicles of Immigrantes Highway in spite of surrounding several housings.
A7	Pump Station （EEE-02）	The project site is located at the empty land along the road of Estrada da Cama Patente, where a football ground and several houses exists around. However, the public facilities such as schools and hospitals do not exist.	The noise impact level is estimated to be larger compared to A8 because of the existence of surrounding houses.
A8	Pump Station （EEE-03）	The project site is located at the empty land along the road of Estrada da Cama Patente, where a gas station exists around. However, no houses exist.	The impact level on noise is estimated to be small because of no existence of houses, schools and hospitals.

(2) Sewage Treatment Project in Isolated Communities

1) Resettlement / Land Issue

In case of Riacho Grande, the project does not require any resettlement nor land acquisition because of its development in existing facility area. While, in Santa Cruz, the project requires land acquisition since the project is planned to be developed at the existing private land. However, it requires no resettlement because of its current land use of empty land (football ground).

Photo 31.2.1 Project Site of Sewage Treatment Project in Santa Cruz

2) Economy

In the same manner of the sewage treatment project in urban areas, the tariff collection is executed for the beneficiaries, which may cause impact on the household economy of the lake residents.

3) Hazard (Accident during Construction)

The operational accidents are anticipated at construction site in spite of its smaller scale and coverage area compared to the sewage treatment project in urban areas.

4) Solid waste

The issue on the treatment or disposal of the sewage sludge is estimated to be caused by the increase of the treatment amount in Riacho Grande and by the new installation of facility in Santa Cruz.

5) Odor

At the sludge treatment process, the alkaline odor (e.g. hydrogen sulfide, methyl mercaptan, methyl sulfide, methyl disulfide, butyric acid, valeric acid, ammonia, trimethylamine) is generally generated by its anaerobic progress. The generation of such odor gas may cause not only the degradation of the work environment and the surrounding complaint origin but also injury accidents in case of high concentration of their gases.

In case of existing Riacho Grande, the complaints about such odor issues have not been identified so far from the surrounding residents. However, the impact on odor is anticipated by the increase of the treatment amount in Riacho Grande and the new development in Santa Cruz.

(3) Permeable Pavement Project

1) Traffic / Public Infrastructure

The project site is located at the existing road areas which are the streets in housing lots in most case, where the domestic wastewater is discharged directly. Some impact on traffic in such areas is estimated although its impact level is estimated small compared to the sewage treatment project because of its smaller traffic volume.

2) Solid waste

The issue on construction waste is anticipated since the stripping of existing pavement or the excavation of the surface layer is planned to be carried out. Therefore, the impact caused by such waste issues is estimated.

(4) Public Park / Green Space Development Project

1) Resettlement / Land Issue

The project site is located at the parking area / empty land along the Alvarenga river and the road of Estrada dos Alvarenga in Alvarenga district. The proposed project requires the process of land acquisition because of its empty land.

Source: Google Earth

Photo 31.2.2 Project Site of Public Park / Green Space Development Project

(5) Environmental Remediation Project of Former Alvarenga Open Dumping Site

1) Resettlement / Land Issue

Several houses (squatters) are identified at the project site as shown in **Figure 31.2.2**. The project site is a former open dumping site and its operation currently has terminated. However, above squatters and the surrounding residents are engaged in the solid waste related works such as collection of valuable resource and recycling. From the situation that above squatters are dwelling inside the project site, the resettlement of above squatters will be necessary when the implementation of the proposed project is decided. The project site had been a quarry site before the operation of the open dumping and its land ownership is established by the former land owners of the quarry business. The process for land acquisition is necessary including the transfer of their land titles.

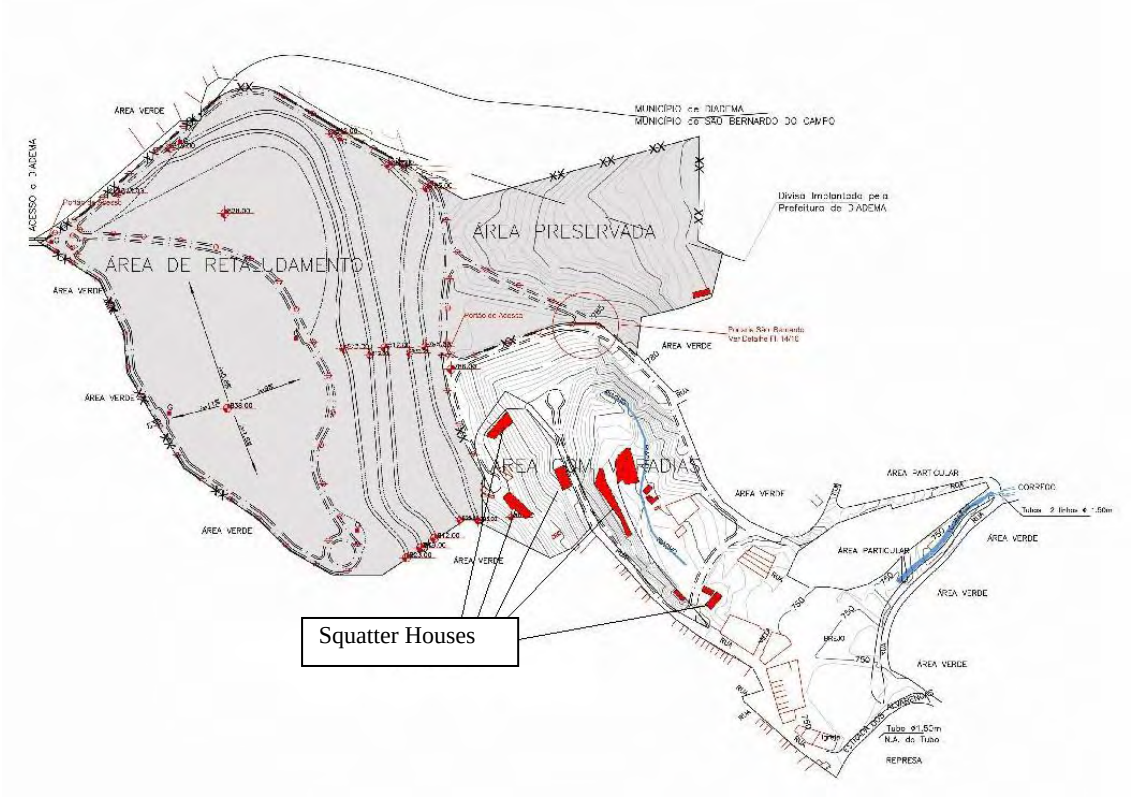


Figure 31.2.2 Location Map of Squatters

2) Hazard

The proposed project has a disaster risk because of ground instability by its former waste sediments and the current steep slopes, which may cause the operational accidents by the collapse of the ground and slopes. At operation stage, additional accidents may be caused by the defect of design and construction and bad manners of operation and maintenance.

(6) Pilot Project for Water Purification using Water Plants

1) Resettlement / Land Issue

No resettlement will be caused by the proposed project since the project is planned in the water area. However, the application for the right of use of water area should be executed from EMAE who is the property manager of Billings Lake.

2) Public Health

The free-floating aquatic plant such as water hyacinth (*Eichhornia Crassipes*) is proposed for the water quality purification. Fences are basically necessary for the prevention of the propagation expansion toward the whole lake area because of its strong fertile power, which may form the flat water and cause infectious disease such as dengue fever by the mass generation of mosquito.

3) Solid waste

Regular mowing is planned to prevent the propagation of above water hyacinth, which may cause another issue of treatment and disposal of their solid waste after mowing.

4) Flora and Fauna

Above strong fertile power of water hyacinth may make it a dominant species and may cause the destruction of the ecosystem of the Billings Lake.

5) Water Pollution

The poor oxygen watermass will be formed by the short-duration coverage of above water hyacinth toward the water surface, which may cause another water pollution that will decrease DO value.

31.2.2 Consideration for Alternatives and Mitigation Measures for Possible Impacts

(1) Consideration for Alternatives

1) Sewage Treatment Project in Urban Areas

The proposed project is to transport the sewage of Alvarenga and Lavras districts outside of the lake basin by developing sewer pipes and pump stations. As mentioned in the chapter of the alternative study on "Sewage Treatment Development in Urban Areas", the basic concept of the sewage treatment of the area is to develop the sewer pipes along Couros River and collect the surrounding sewage into their sewer lines. The proposed project (Alternative 1) is to allocate the relevant facilities along Couros River as much as possible. However, all the project site of the proposed project is not public road areas and it partly crosses the private lands or factory areas. Alternatives of 2 to 4 as the alternatives of the proposed project (Alternative 1) have the resettlement and land issue except Alternative 3. Alternative 3, on the contrary, cannot be adopted since it contributes the least effect on the environmental improvement of Billings Lake because of its smallest reduction of domestic sewage pollutant among the alternatives.

Above all alternatives are planned to be developed at public road areas and equipped with pump stations, which will bring the common issues of traffic / public infrastructure, hazard (accident during construction), economy and noise.

2) Sewage Treatment Project in Isolated Communities

No resettlement may be caused by the proposed project except the issue of land acquisition in Santa Cruz. The proposed site of Santa Cruz has already been planned as a candidate site for the sewage treatment by SBC city, which may not bring hard problems for the realization of land acquisition. An alternative of transporting the sewage of the planned areas into the existing sewage facilities at the northern areas of Billings Lake which was already studied before, may cause other issues of impact on the capacity of existing sewage treatment facilities as the reception of planned sewage and the issue of installation of pressure pipes as essential facilities.

No resettlement is caused by the proposed project except the issue of land acquisition in Santa Cruz.

Above alternatives have the common issue for the hazard (accident during construction) since all alternatives have to accompany construction works and the common issue of local economy to be caused by the tariff collection which should be imposed by the additional provision of treatment service of the sewage treatment.

As for the solid waste issue (sewage sludge) to be caused by the generation of sewage sludge, zero option (no facility for sewage treatment is developed) will bring no bottleneck removal for the environmental improvement of Billings lake because of the direct discharge of its untreated effluent of domestic sewage into the lake basin. The situation on sewage sludge treatment in other alternatives of transporting the sewage into existing sewage treatment facilities is same with those of the proposed project since the sewage sludge is increased at the final treatment plant in other alternatives.

As for the issue of odor, although the alternatives for transporting the sewage into the existing treatment facilities will bring less issue of odor, it may bring another issue of the impact on the capacity of existing sewer pipes. At Riacho Grande, no complaints have been identified from the surrounding residents up to now. Odor issue will be mitigated by the appropriate measures from the facility improvement when complaints are identified.

3) Permeable Pavement Project

The consideration for the alternative study is excluded here since the alternatives for the proposed project have the same issues for traffic and solid waste during construction.

4) Public Park / Green Space Development Project

The consideration for the alternative study is excluded here since the proposed project site has been planned as a candidate site for a public park and green space development by SBC city with no other alternative sites.

5) Environmental Remediation Project at Former Alvarenga Open Dumping Site

The facility development for the treatment for the leachate as one of the pollutants in Billings Lake basin and its safety improvement including appropriate resettlement of the squatters is essential. There are no other alternatives for the proposed project for accomplishing such objective.

6) Pilot Project for Water Purification using Water Plants

Water quality purification by the use of emerging plants such as phragmites and reeds can be an alternative for the proposed project. However, the alternative requires the take-in of the soil dressing for keeping water depth, pretreatment for forming appropriate water quality state for cultivating above emerging plants (for reducing BOD value to approximately 20 ppm). Is such case, the alternative needs to carry out regular dredging, which may cause another issue of treating, transporting and final disposal of the dredged soils.

(2) Mitigation Measures

1) Resettlement / Land Issue

Sewage Treatment Project in Urban Areas

The following mitigation measures are recommended for the resettlement issue when the implementation of the proposed project is decided.

- Preparation of public communication program
- Formulation of negotiation channel with the affected residents
- Preparation and implementation of appropriate resettlement plan securing dwelling houses, appropriate notice to affected residents and implementation of their plans

The details of above public communication program are shown in **Table 31.2.5**.

Table 31.2.5 Public Communication Program

Item	Details of Program
Objective	• Public information disclosure regarding project plan, project feature and its environmental conservation plan • Appropriate response to the requirements of public • Implementation of communication with communities Consensus building with communities
Point	• Notice on the proposed project • Build-up of trustful relations • Integration of different community groups • Implementation of environmental education • Response to emergency situations

SBC city is currently implementing the housing developing based on the finance support of Urban Housing Development Company of Sao Paulo State (CDHU: Companhia de Desenvolvimento Habitacional e Urbano do Estado de São Paulo) directed toward the low-income inhabitants (on a priority basis, to the residents with 1 to 10 times of the legal minimum wage, 350 R$). The basin residents have not made significant opposition.

SBC city has a resettlement plan for the ullegal and sub-normal areas along the Courous River which is located at the project site and intents to make appropriate measures conforming to such resettlement plan.

The impact on the land issue should be mitigated as the following manners.

- Preparation of public communication program and its actual implementation
- Appropriate negotiation with the residents including land owners and its consensus building

Land expropriation can be executed in accordance with the article of 5 of Federal Decree Law of 3.365/41 (Decreto Lei 3.365/41) in case that a project has high public nature.

Above land expropriation is executed based on the procedures shown in **Figure 31.2.3**, where two basic steps are composed of 1) declaration of land expropriation by a regulartory authority (e.g. state /

municipality governor) and 2) execution of land expropriation. When mutual agreement is not reached at the process of 2), the compensation amount is decided through court.

Sewage Treatment Project in Isolated Communities

In Santa Cruz, the land acquisition process for the existing empty land (football ground). Although he land has already been prepared for land secure as its project site, the transfer of the land title has not been made from the land owners to SBC city and it requires above procedures of **Figure 31.2.3**.

Environmental Remediation Project of Former Alvarenga Open Dumping Site

As mentioned before, the following measures should be made for the resettlement.

- Preparation of public communication program
- Formulation of negotiation channel with the affected residents
- Preparation and implementation of appropriate resettlement plan securing dwelling houses, appropriate notice to affected residents and implementation of their plans

Sao Paulo state is currently conducting the urban upgrading process including the resettlement of the subnormal residents based on the Water Resources Conservation Program (Programa Mananciais) financed by World Bank. SHAMA of SBC city plans to relocate the surrounding 113 households including the squatters dwelling of the proposed project site at Alvarenga district to the public apartment which is under construction. According to SHAMA, the squatters concerned have agreed with above resettlement plan. The resettlement is scheduled to be completed by the next year.

The progress of above resettlement should be confirmed by the project progress.

The land acquisition issue caused by the proposed project should be appropriately conducted based on its procedures as shown in **Figure 31.2.3**.

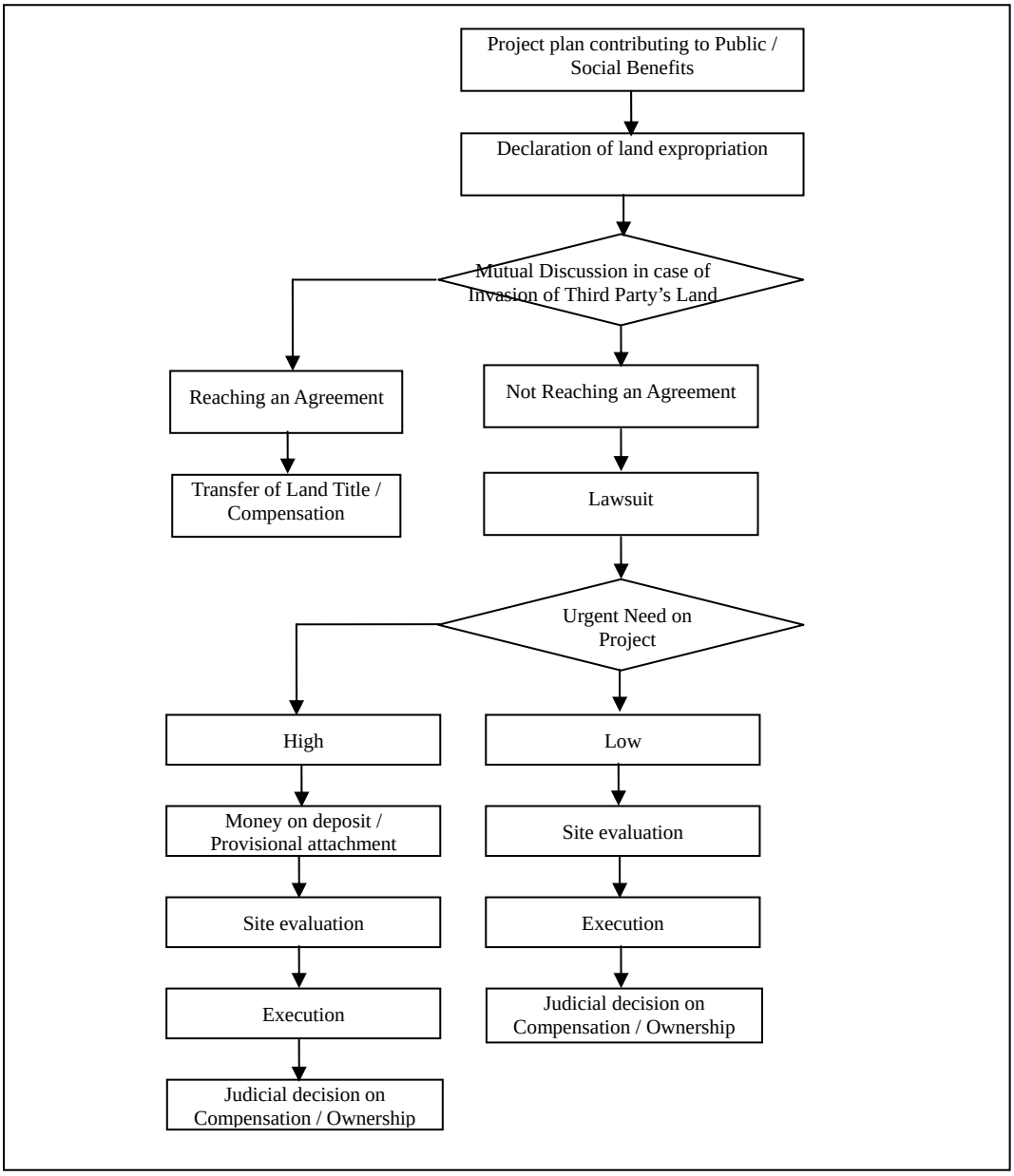


Figure 31.2.3 Procedures on Land Expropriation

Pilot Project for Water Purification using Water Plants

The acquisition of the right of water area is indispensable since the proposed project is implemented in Billings Lake. Since the state organization including EMAE is the administration authority of Billings Lake, the appropriate consultation with the authority and their approval should be made for the use of the water area.

Although the proposed project is estimated to be coordinated by the initiative of SBC city as part of the operational program of Environmental protection Center, various organizations such as Sao Paulo State water resource department, water resource committee, basin committee and state environmental department are currently involving with the administration of Billings Lake including water resource and environmental conservation. Therefore, appropriate coordination with

such organization should be made.

2) Economy

Sewage Treatment Project in Urban Areas, Sewage Treatment Project in Isolated Communities

The impact on the residents in low-income level is estimated by the tariff collection in the sewage treatment projects in urban areas and isolated communities. Project proponent (SABESP) released the low tariff collection system directed for the vulnerable residents to above impact in January 2006 based on Sao Paulo State Decree-Low of 41,446/96. **Table 31.2.6** shows the details of the tariff system for the three classes comprising of subnormal, low-income and normal households who are dwelling in SBC city. The tariff collection system as shown in **Table 31.2.6** should be applied for the implementation of the proposed projects. The public enlightenment or environmental education should be conducted at the same time related to the necessity of above tariff collection in order to provide public awareness upgrading.

Table 31.2.6 Water Tariff directed for Dwellers in SBC city released by SABESP

Water Consumption by Household Class (m^3/month)	Water Tariff (R\$/m^3/month)	Sewage Tariff[2] (R\$/m^3/month)
Low-income Households[1]		
0～10	2.97	2.97
11～20	0.43	0.43
21～30	1.46	1.46
31～50	2.99	2.99
Above 50	3.30	3.30
Sub-normal Households		
0～10	2.62	2.62
11～20	0.29	0.29
21～30	0.99	0.99
31～50	2.99	2.99
Above 50	3.30	3.30
Normal Households		
0～10	9.17	9.17
11～20	1.16	1.16
21～50	2.70	2.70
Above 50	4.26	4.26

Note)
1) This household is called as "Residential Social" in accordance with Sao Paulo State Decree-Low of 41,446/96, which is defied as follows;
A single household who is earning the income below three times of the legal minimum wage and paying the electricity tariff below 170 kWh/month, or, who is currently dwelling at a housing complex after urban upgrading process from their former dwelling slums (Favela).
2) The same amount of water tariff (100%) is collected

3) Traffic / Public Infrastructure

The safety measures during construction should be made by preparing tender documents including contractor's preparation of the documents for the environmental conservation plan for construction works (PAC: Plano Ambiental para Construcao) based on Federal Law of 6,514/77 and its enforcement regulations 3,218/78 for the estimated impact on the traffic and existing infrastructures (utilities) such as gas and water pipes.

As for the impact on the surrounding traffic, project proponent should conduct prior report to the

traffic department (SMT: Secretaria Municipal Transporte) in SBC city for the application for the project implementation. For the construction works, the measures such as setting traffic signs or allocating guides for traffic control should be considered in order not to bring obstacles to the surrounding traffic.

For the possible impact on existing utilities, the prior consultation with the relevant authorities (e.g. Comgas, Eletro Paulo, etc.) and survey on burial situation around the project site should be carried out.

At the tender stage of the proposed project, the division of responsibility should be clarified in tender documents regarding the requirement on the measures on traffic control or the indemnification on the damage to existing buried utilities.

4) Public Health

Pilot Project for Water Purification using Water Plants

In the Pilot Project for Water Purification using Water Plants, the water purification is planned as a pilot investigation only in the limited area by installing fences. However, operation and maintenance such as regular mowing works for preventing is necessary for the prevention of the reproductive expansion of such water plants. Monitoring for the generation status of the mosquito should be conducted. Furthermore, terminating the project can be also an option when massive generation of mosquito is identified since the proposed project planned to be implemented as a pilot project.

5) Flora and Fauna

Pilot Project for Water Purification using Water Plants

For the impact on the surrounding ecosystem to be caused by the proposed project, as mentioned before, the operation and maintenance such as regular mowing of water plants (water hyacinth) should be conducted for the prevention of above reproductive expansion.

6) Solid Waste

Sewage Treatment Project in Isolated Communities

The overload burden at the reception facility of the sewage sludge should be avoided by reducing the sludge amount through the dewatering. ABC final treatment plant is planned as a final reception of the generated sludge, which has been planned as a reception facility of the sewage of ABC region (including SBC city) by SABESP. However, the facility is currently operating only at 50 % of its maximum capacity, which means that there seems no problems on the reception of the planned sewage sludge.

Permeable Pavement Project

The possible construction solid waste (road pavement material, excavated material, etc.) should be treated appropriately in accordance with NBR 10004 of the Brazilian Technical Association

Standard (ABNT: Associação Brasileira de Normas Técnicas）.When construction waste is actually generated by the proposed project, the appropriate final disposal at LARA final landfill site which is authorized as a final disposal site to receive construction waste at its distance of approximately 20 km from the city center of SBC city.

Table 31.2.7 Regulation on Treatment and Disposal of Construction Waste based on CONAMA Resolution

No. of Resolution	Regulations
03/93	Classification of solid waste in accordance with ABNT standard, NBR 10004
06/88	Regulation on classification of industrial waste
23/93	Classification of solid waste in accordance with ABNT standard, NBR 10004
307/02	Regulation on construction waste
313/02	Regulation on state-level inventory on the purpose of data collection on the generation amount of industrial waste, waste type and final disposal

Pilot Project for Water Purification using Water Plants

According to the proposed project, the treated water hyacinth after its purification is planned to be transported to existing ABC final treatment plant and disposed of there. Project proponent should consult about the disposal of water hyacinth for the application of the project implementation with SABESP who is the administrative authority of the final treatment plant. A program for the utilization of above water hyacinth for producing organic fertilizer can be one option on a trial basis in the proposed project.

The following shows some samples of effective utilization of water hyacinths.

1. Biomass conception using water hyacinth in Japan (Fukuoka Prefecture)

The solid waste of water hyacinth is composted by 1) being collected by machine or man power of the local residents, 2) being dried up and fractured and 3) finally mixed with livestock compost and sawdust. The produced compost is delivered to the local farmers.

2. Manufacturing of furniture by using water hyacinth in Thailand

There has been a custom of knitting basket by using plants in Thailand. However, they don't have the customes of producing big furniture by plants. One businesswoman developed a new way of knitting water hyacinths into furniture in several years, instructed farmers the knitting know-how and made them into commercial realization The produced furniture has been not only sold to the surrounding countries but also exported to European countries of France or Germany with high popularity.

7) Water Pollution

Pilot Project for Water Purification using Water Plants

The same manners of regular mowing of water hyacinth as mentioned in above Flora and Fauna should be applied for the issue of the formulation of poor oxygen watermass. In addition, regular monitoring for water quality should be conducted for such poor oxygen state. Furthermore,

terminating the project can also be one option for the issue of water pollution.

8) Noise

Sewage Treatment Project in Urban Areas

As for the possible noise impact, appropriate design and the operation of the pump station should be conducted in order to comply with the regulation of NBR10151 in **Table 31.2.8** which is the Brazilian noise standard (ABNT) in ambient noise environment. In addition, the regular monitoring for noise at operation should be conducted

Table 31.2.8 Evaluation Standard in Ambient Noise based on NBR 10151

unit : dB(A))

Location	Day	Night
Farmland or ranch	40	35
Surrounding areas of hospitals	45	40
Urban residence areas	50	45
Mixed areas with high occupation rate of housings	55	50
Mixed areas of shopping area and offices	60	55
Mixed areas with recreation zone	65	55
Mixed areas within 40m in parralell with the areas of traffic stream	70	55
Areas with high occupation rate of factories	70	60

9) Odor

Sewage Treatment Project in Isolated Communities

The complaints for the odor have not been identified so far from the surrounding residents at existing Riacho Grande sewage treatment plant.

However, the following measures should be considered when complaints about odor is generated newly by the proposed project.

- Measures from the aspect of facility design that can collect the odor by fan in order not to be leaked into the surrounding houses
- Establishment of response organization to the complaints from the residents

Pilot Project for Water Purification using Water Plants

As for the anticipated impact on odor caused by the dried water hyacinth, appropriate operational plan and its implementation for mitigation odor (e.g. utilization of absorbent at treatment process) should be prepared and conducted.

10) Others

Environmental Monitoring

Regular monitoring for the effluent water and at lake water area should be conducted based on the national standards of CONAMA Resolution of 20/86 at the operation stage of the sewage treatment project in isolated communities and the pilot project for water purification using water plants. In addition, regular monitoring for the generation of mosquito should also be conducted.

Environmental Remediation Program

For the designated site of the former open dumping site at Alvarenga district which requires CETESB's remediation process, project proponent should conduct the study / survey based on the appropriate manners as mentioned before and mitigation measures for remediation / restoration.

Urban Upgrading Process by SBC City

Illegal or subnormal areas are located in terms of water resource conservation and land use restriction around the project site of the proposed sewage treatment project in urban areas, although these areas are not directly affected by the proposed project. SBC city will have to develop the urban upgrading process in such areas, which may cause resettlement partly. In that case, SBC city should conduct appropriate response to above impact by preparing public communication program, establishing resettlement plan and securing relocation sites.

31.3 Stakeholder Meeting

According to the JICA Guideline for Environmental and Social Consideration, stakeholder meetings are to be held depending on the needs for the full-scale development study of the proposed case. For the reason, stakeholder meetings were held as shown in **Table 31.3.1**. The background / objective of the study, current situation on the water pollution of Billings Lake, introduction of priority projects for the pollutants reduction, possible environmental / social impacts and their mitigation measures were disclosed to the public, and followed by the comments from them.

Table 31.3.1 Methods of Stakeholder Meetings

Item	Details of Content
Method of publicity	Door-to-door visits of the relevant households and distributing invitation cards after preparation of invitation cards.
Area of publicity	The possible affected areas by the proposed projects comprising of two communities in Billings southern and northern lakeside (Riacho Grande, Santa Cruz, Alvarenga districts)
Date	July 28th and 29th, 2006
Place of Meetings	1) Suzzuette Abaresida Campos primary school (Riacho Grande, SBC city, July 28th) 2) Fransico Bertoran Batistini primary school (Alvarenga, SBC city, July 29th)
Target for publicity	Local residents, community leaders, NGO and relevant authorities
Method for progress	The staffs of SBC city office (Director-general and director of information and planning department) made explanation on background / objective of the study, current situation on the water pollution of Billings Lake, introduction of priority projects for the pollutants reduction, possible environmental / social impacts and their mitigation measures by using presentation materials. After that, the comments were collected from the attendance.

Table 31.2.2 shows the results of above stakeholder meetings. As shown in **Table 31.2.2**, various comments were collected from the surrounding issues to environmental education. In addition, the SBC city staffs separately responded to the request from the attendance in July 29th that the residents want to meet with the study team locally.

Table 31.3.2 Results of Stakeholder Meetings

Date	Major Comments
July 28th	• How can the residents at Alvarenga district participate in the stakeholder meetings? • Can septic tank spread locally at early days, and which organization conducts the guidance of its use? • Can we introduce environmental education into schools subject from primary school to universities? • Do the microcystis growing in Billings Lake have toxicity? We request SBC staffs to explain more details about its impact on the lake. • Does the study include the impact to be caused by the soil discharge at non-pavement areas into the lake? • How can you spread the proposed technology locally? • We have confirmed that the environmental education will be implemented in primary schools. However, can we also take such education in middle schools or universities? （Participants: Approximately 40 people）
July 29th	• We request you to contact with the study team to meet with the community leaders. • We request you to answer how the city office treats the issues of clogging sewage pipes near our houses.. • Has the JICA study been brought into SBC city master plan? （Participants: Approximately 30 people）

Riacho Grande District

Alvarenga District

Photo 31.3.1 Stakeholder Meetings

Chapter 32

PROJECT IMPLEMENTATION PROGRAM

32. PROJECT IMPLEMENTATION PROGRAM

32.1 Implementation Schedule and Cost Estimates

32.1.1 Implementation Schedule

Implementation schedule is shown in **Figure 32.1.1**. The projects will be initiated by the procedures for the international lending agency and domestic institutions in 2007 with a goal to conclude the loan agreement within the same year. Consultants will be selected in 2008 and start the detailed design of the facilities proposed from its mid-year. Contractor will be decided in 2009 to commence the construction work from 2010 and complete by 2014.

Negotiation with the international lending agency	12 months
Application for COFIEX's approval	12 months
	(Parallel works with the above)
Selection of consultants	6 months
Detailed Design	42 months
Construction supervision	60 months
	(Parallel works with the detailed design partially)
Selection of contractor	12 months
Construction work	60 months

Period of 42 months for the detailed design is due to regularization process of sub-normal residential areas during the detailed design. The areas are located in the northern part of the Lake Billings basin. This process is significant for the project implementation, since the regularization of sub-normal residential areas is indispensable for the construction work and its pollution load has been seriously affecting the water quality in the Lake Billings.

32.1.2 Cost Estimates

Projects to be undertaken by Sao Bernardo do Campo are as follows;

1) Environmental Center
2) Permeable pavement
3) Park provision
4) Remediation of the former Alvarenga solid waste dumping site
5) Installation of a pilot plant for lake purification using aquatic plants

Projects to be undertaken by SABESP are as follows;

1) Sewerage in the urban areas
2) Sewerage in the isolated communities

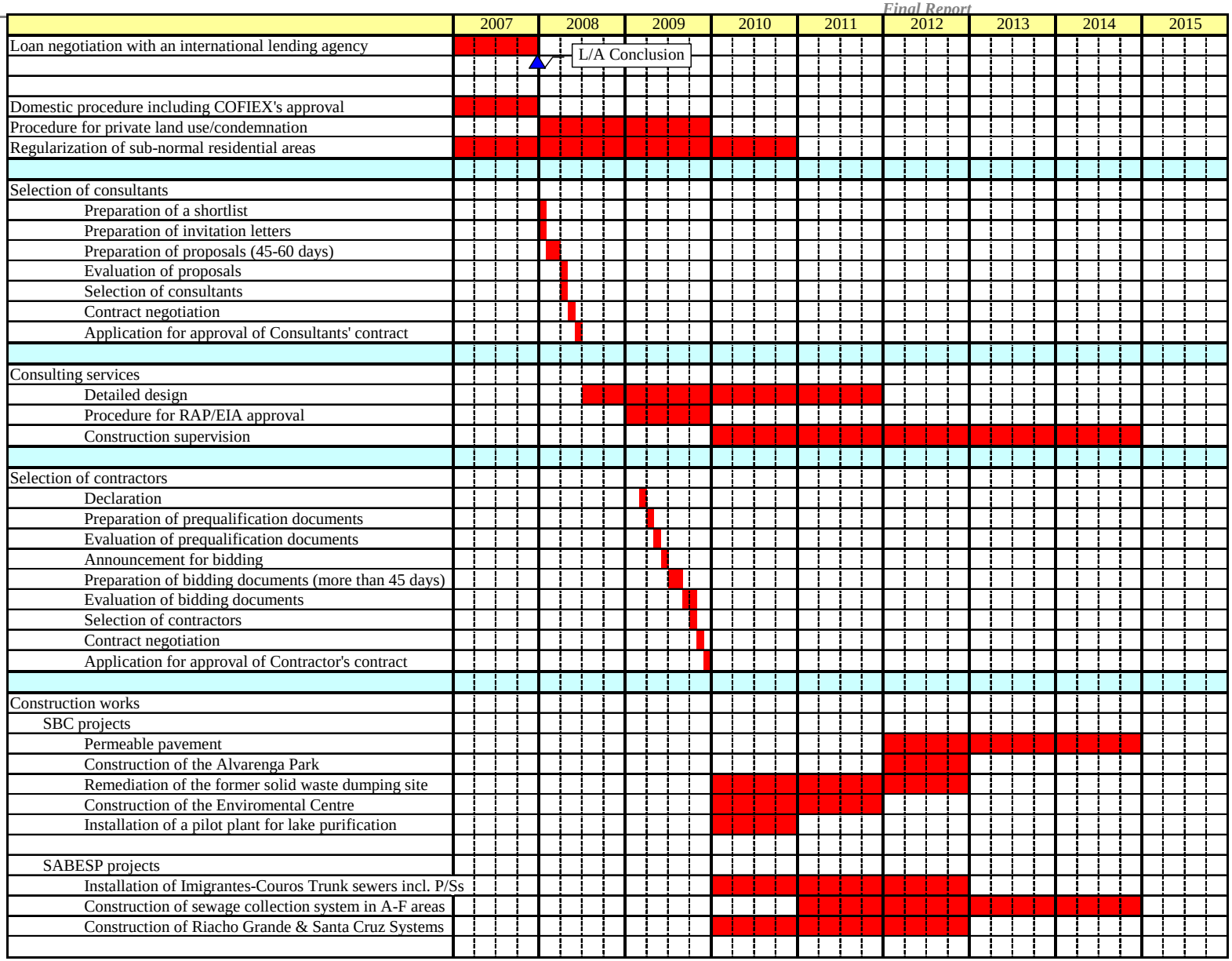


Figure 32.1.1 Project Implementation Program

Table 32.1.1 Cost Estimates

Agency	Project	R$	Equivalent JY	Remarks
SBC	Permeable pavement	25,879,000	1,348,500,000	
	Remediation of the old Alvarenga solid waste dumping site	11,965,000	623,400,000	
	Construction of the Alvarenga Park	1,848,000	96,200,000	
	Construction of the Environmental Center	8,192,000	426,800,000	
	Installation of a pilot plant for lake purification using aquatic plant	665000	34,600,000	
	Sub-total	48,549,000	2,529,800,000	
SABESP	Sewerage construction in the urban areas			
	trunk sewer system	54,571,000	2,843,600,000	
	pumping stations and force mains in Area A	21,660,000	1,128,700,000	
	Sewage collection network in Area A-F	37,215,000	1,939,200,000	
	Sub-total	113,446,000	5,911,600,000	
	Sewerage construction in the isolated communities			
	Riacho Grande system	16,632,000	866,600,000	
	Santa Cruz system	4,430,000	230,800,000	
	Sub-total	21,062,000	1,097,500,000	
	Sub-total	134,508,000	7,009,200,000	
	Total	183,057,000	9,539,100,000	
	Consulting services	14,780,000	770,100,000	
	Contingency Construction cost x 0.1	18,306,000	953,900,000	
	Land cost	3,388,000	176,500,000	Out of subject to loan
	Grand total	219,531,000	11,439,700,000	
<Classification by expence Items>				
SBC	Construction cost	48,549,000	2,529,900,000	
	Consulting services	3,399,000	177,100,000	
	Contingency Construction cost x 0.10	4,855,000	253,000,000	
	Land cost	1,692,000	88,200,000	
	Total	58,495,000	3,048,200,000	
SABESP	Construction cost	134,508,000	7,009,200,000	
	Consulting services	11,381,000	593,100,000	
	Contingency Construction cost x 0.10	13,451,000	700,900,000	
	Land cost	1,696,000	88,400,000	
	Total	161,036,000	8,391,600,000	
	Grand total	219,531,000	11,439,700,000	

32.2 Method for Project Implementation

32.2.1 Contract Package for Construction Works

From the viewpoint of international bidding, it is desirable to minimize the number of contract packages in order to urge many contractors to join the bidding, however, due to the constraints accompanied with projects proposed as stated below, they are inevitably divided into some contract packages.

- The projects are classified into two groups to be undertaken by the Municipality of Sao Bernardo do Campo and SABESP, respectively.
- For the permeable pavement under the Municipality of Sao Bernardo do Campo, its construction work shall take longer period for the process of regularization of sub-normal residential areas compared with other construction works.
- The project under SABESP needs regularization of sub-normal residential areas as well.

From the situation mentioned above, the following contract packages are suggested:

For the projects under the Municipality of Sao Bernardo do Campo

Package 1 Remediation of the former Alvarenga solid waste dumping site＋Construction of the Environmental Centre + Installation of a pilot plant for lake purification using aquatic plants

Package 2 Permeable pavement＋Construction of the Alvarenga Park

The project under SABESP

Package 3 Sewerage construction in the urban areas Lot 1（Trunk sewers from Imigrantes to Couros including three pumping stations）

Package 4 Sewerage construction in the urban areas Lot 2＋Lot 3 (Areas A to F)

Package 5 Sewerage construction in the isolated communities

Alternatives contract packages are as follows:

a) To include sewerage construction in the isolated communities of Package 3 in Package 5

b) To include the permeable pavement of Package 2 in Package 4

The above b) is proposed since excavation, sewer installation, backfilling and permeable pavement should be dealt in a sequence of construction works. Two contractors will have to arrange their schedule in one construction site.

International competitive bidding shall be applied in the bidding under the international lending agency in general. However, local bidding can be applied under the approval of the international lending agency for the package international contractors will not be interested in because of the

contents or scale of the construction work.

32.2.2 Implementation Process

The project implementation is classified into the following six steps.

a) Financing

b) Selection of consultants

c) Detailed design and preparation of tender documents

d) Selection of contractors

e) Construction works and turnover

f) Operation and maintenance

The selection of consultants and contractors is usually done in accordance with the guidelines of contractors.

32.3 Indicators for Operation and Effect

32.3.1 Indicators for Operation

1) Sewerage coverage (%)

SABESP counts the population connected to sewer system as covered by sewerage service in the calculation of sewerage coverage and collect sewage charge from such residents. In fact, considerable numbers of people have been paying the sewage charge in the basin of the Lake Billings, although almost such sewage is actually discharged into the Lake Billings without treatment. The detailed information of the current numbers and locations of connections and the year of connection is necessary to grasp the existing operational condition and beneficiaries attributed to the proposed projects.

2) Sewage flowrate transferred outside of the basin (m^3/day)

This indicator gives the information of the flowrate of sewage transferred to outside the basin. It shall be acquired by installing flow meters at pumping stations for measurement and recording.

3) Water quality of inflowing sewage to the Alvarenga Pumping Stations (mg/L)

Concentrations of BOD, COD, SS, TN and TP in incoming sewage are obtained through the regular monitoring at the Alvarenga Pumping Station (EEE01).

3) Sewage flowrate incoming to the sewage treatment plant (m^3/sec)

The sewage flowrate is obtained by installation of flow meters for measurement and recording at

both of Riacho Grande and Santa Cruz Sewage Treatment Plants to be constructed under the Project for the sewerage construction in the isolated communities.

4) Water quality of influent and effluent of the sewage treatment plants

The concentrations of BOD, COD, SS, TN, TP and others in influent and effluent shall be obtained through the regular monitoring at Riacho Grande and Santa Cruz Sewage Treatment Plants.

32.3.2 Effect Indicators

1) Runoff pollutant load to the Lake Billings

This indicator shall be calculated based on population, septic tank usage rate, sewerage service coverage, sewage flowrate transferred to outside the basin, sewage flowrate and quality of effluent treated at Riacho Grande Sewage Treatment Plant and Santa Cruz Sewage Treatment Plant.

2) Load reduction to the Lake billings

Load reduction shall be calculated from the result of 1) and yearly changes.

3) Water quality of the Lake Billings

In addition to the data regularly monitored by CETESB and SABESP, the data to be provided by the proposed Environmental Centre will be newly available to monitor the condition of lake water.

Chapter 33

CONCLUSION AND RECOMMENDATION

33. CONCLUSION AND RECOMMENDATION

(1) Raise of sewerage coverage

The biggest pollutant source in the basin of the Lake Billings is domestic sewage, of which only 8% is treated at the sewage treatment plants and the remainder is discharged into the lake without any treatment. Therefore, the first priority should be given to reduce the pollutant loads in the basin of the Lake Billings. For this reason, the project for sewerage construction in the urban areas and isolated communities is planned so as to connect their laterals to a sewer system immediately, if the residents want, by providing the public inlets in front of their houses.

The subject after project implementation relies on to what extent the sewerage coverage can be raised in the basin of the Lake Billings. According to the environmental and social awareness survey, people in the basin have less awareness on their contribution to water pollution and low willingness-to-pay for sewage charge, while high concern on their involvement in the activities for basin environment improvement. It suggests the possibility that the people's awareness can be changed if any prompt is given. For this purpose, it is very important for them to feel that they are also ones of polluters and have motivation that they have to connect their sewage to a sewer system in the earliest time through the public enlightenment, environmental education and activities of the Association of "Clean the Lake Billings".

It is considered as an effective means to require their connection to a sewer system and payment of sewage charge in the course of regularization of sub-normal residential areas, as described later.

The execution agency of sewerage construction is SABESP, but the public health centre is responsible for the promotion of sewerage coverage. It is recommended, however, that the agencies concerned with such as SABESP, municipalities and the public health centre will cooperate together in the campaign for promotion of people's connection to a sewer system.

(2) Promotion of regularization of sub-normal residential areas

There is no doubt that the biggest pollutant source in the basin of the Lake Billings is domestic sewage. If the sub-normal residential areas mostly located along the lake are left as they are, the proposed sewerage construction lack finishing touches. For these sub-normal residential areas, their regularization should be promoted with conditions of their connection to a sewer system and payment of sewage charge. The agreement (called TAC) among third parties composed of the community, municipality and environmental prosecutor defines each responsibility for regularization. But the implementation of sewerage construction by SABESP will alleviate the burden accompanied with each responsibility. Instead, the conditions of their connection to a sewer system and payment of sewage charge is, therefore, fully justifiable and the essential requirements directly concerned with the basin environment improvement of the Lake Billings.

(3) Early establishment of the Association of "Clean the Lake Billings"

Since the basin environment improvement of the Lake Billings is not attainable by the effort of Sao Bernardo do Campo only, it is indispensable for all the stakeholders in the basin to cooperate, share the responsibility and act together toward the goal. For this purpose, the early establishment of the Association of "Clean the Lake Billings" and action of all the stakeholders in a body is required. The ABC Consortium or the regional intercity association is expected to play a role as the base for the Association of "Clean the Lake Billings". Five out of six municipalities involved in the basin excluding Sao Paulo belong to the Consortium as well as other two municipalities such as Caetano de Sur and Maua, and also the members of the committee to discuss what the basin of the Lake Billings should be. The mayor of Sao Bernardo do Campo is the present president of the Consortium and in a position to get cooperation easily from other members.

The key for success depends on the participation of Sao Paulo. The Municipality of Sao Bernardo do Campo has the biggest administrative area and water surface area in the basin of the Lake Billings, but Sao Paulo shares 54.3% of the basin population and is the biggest pollutant source in the basin. As no participation of Sao Paulo reduces the effect by half, it is recommended to strongly work Sao Paulo to participate in the activities of the Association of "Clean the Lake Billings".

(4) Joint management of the Environmental Centre

All five projects proposed for Sao Bernardo do Campo produce no income at present and, even though obtaining the loan from international assisting agency, the Municipality has to bear the own burden and repayment of loan and interest for the loan in the investment cost, and operation and maintenance cost for a long term. Among others, the operation and maintenance cost for the Environmental Centre shares 64% in the total O&M cost. The Environmental Centre is able to make income by its management manner. One approach is to transfer the sole management by the Municipality of Sao Bernardo do Campo to the joint management by the municipalities involved in the basin and to share the expenditures, by opening the use of the Environmental Centre to the basin people. Participation in such a joint management is expected to grow an awareness of solidarity and to elevate sustainability for basin environment improvement among municipalities.

(5) Experimental approach for lake purification using aquatic plants

According to the experiences in lake purification in Japan, there is sometime less water quality improvement of the lake than expected in spite of the progress of sewerage coverage. In such case, purification using aquatic plants has been studied and tried in Japan. It may be too early to start the study of lake purification using aquatic plants at a level of 8% in sewerage coverage in the Billings Lake. But such study hasn't been conducted in Brazil and the experimental approach is

proposed to collect the know-how thereof in the early stage. The cause that water hyacinth, which is found here and there in the Lake Billings, does not grow explosively in the Billings Lake, possibility of flush of dengue-transmitting mosquitos in the pilot plant, absorption rate of nitrogen and phosphorous by aquatic plants, harvest amount of water hyacinth and its final disposal method will be the possible themes for the study.

(6) Pollutant loads by elution from sediments and dredging of sediments

It is found that a large quantity of sediments piled in the bottom of the Lake Billings. However, the actual situation of pollutant loads by elution from sediments is not clear, since the studies on elution from sediments in the lake have little done in Brazil, which makes it difficult to predict the pollutant loads by elution from sediments accurately. It is a probable result that nitrogen and phosphorous will not attain the water conservation targets, even though constructing sewerage facilities in the basin of the Lake Billings. For this reason, it is indispensable to exert for studying elution from sediments in the lake and for grasping pollutant loads by elution accurately. As the dredging of sediments piled in the lake bottom requires a huge investment and long periods, it should be reviewed based on the results of elution from sediments.

(7) Importance of public enlightenment and environmental education

Once the lake has been polluted, it is difficult to restore its previous water quality. In parallel with implementing the engineering measures, the people in the basin, understanding the importance of the Lake Billings, are required to order their lives according to the rigid rules, or “No discharge, No pollution” so as to share in the bounty of nature. For this reason, it is recommended to conduct public enlightenment and environmental education to the people through various channels such as school, community, media, etc more than ever.