### 6) Electrical and control system

All equipment in the sewage treatment station as well as all pumps in the pump stations of the Conceicao Sewerage System shall be collectively supervised from the integrated supervisory board. This shall be installed in the control room of the administration building.

### 7) Buildings and civil works

The following building construction and civil works shall be carried out:

(a) Buildings

| | |
|---|---|
| Influent pump room: | 10 m wide x 10 m long, |
| Recirculation pump room: | 10 m wide x 12 m long, |
| Disinfection room: | 10 m wide x 12 m long, |
| Administration building: | 20 m wide x 22.5 m long (two-storey) |

The administration building shall accommodate rooms such as: control room, administration room, dehydration room, chemical room, sludge cake room, electrical room, laboratory, staff room, workshop, storage, resting room with toilet and conference room.

(b) Civil works

Civil works shall include miscellaneous structures in the station yard, such as: guard fence and gates, landscaping, parking lots, rainwater drainage, etc.

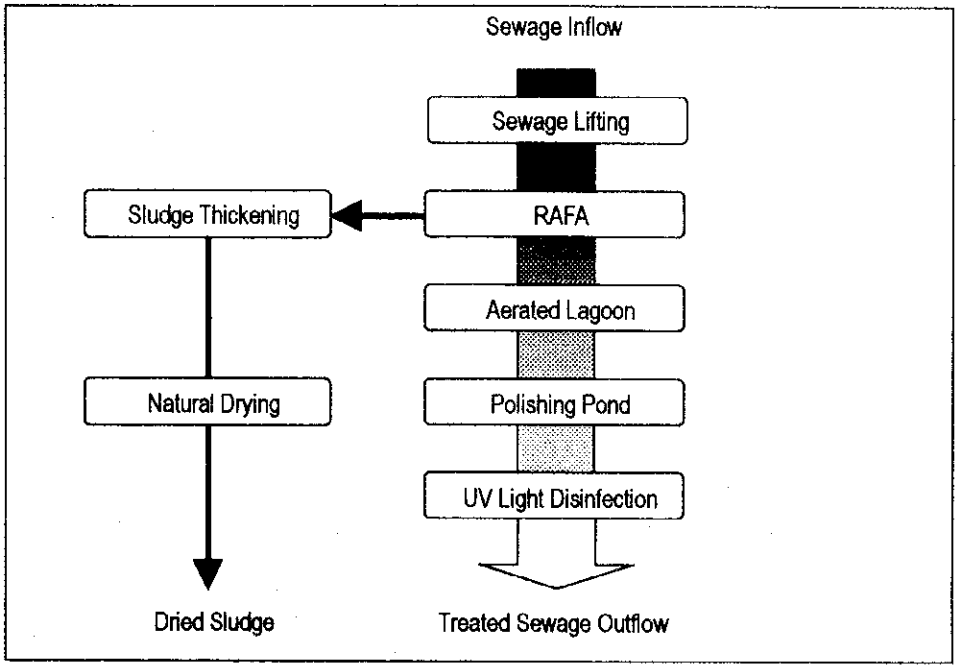
## 6.7 Prazeres STF

### (1) General

The Prazeres STF consists of the following steps: the "RAFA + acrated Lagoon + polishing pond" for the biological treatment system and the "natural drying" for the sludge treatment system, as shown below.

Treated sewage shall be discharged by gravity into the Jaboatao River through embedded discharge pipes. The sludge generated from the treatment facilities shall be disposed of at landfill sites, after being dried naturally at the STF site and transported.

**Treatment Flow of Prazeres STF**




The flow diagram, the hydraulic profile and the layout plan of the facilities shown in Fig. B.6-16, Fig. B.6-17 and Fig. B.6-18, respectively are the results of preliminary design.

### (2) Construction site

The site is situated at the locally determined coordinates, 2.87E / 90.97N, in the Municipality of Jaboatao. The site lies in an industrial zone between the BR-101 highway and a railway. The available land area is of 12.1 ha and it belongs to several private citizens.

At present, the land is almost vacant with bushes and trees. A shallow lagoon occupies a part of the site. The site is surrounded by factory buildings to the south and to the east.

The ground at the site is undulated between 6.5 m and 9 m (+ MSL). The STF shall be constructed on the plot at a level of 5.0 m (+ MSL), which is to be prepared by reclamation and grading to prevent the site from submersion and to discharge treated sewage by gravity.

### (3) Major facilities and structural works

#### 1) Influent system

(a) Grit chamber

The grit chambers are designed to remove coarse substances like sand by gravity separation and equipped with motor-driven bucket conveyers to remove settling

materials on the bottom of the chamber. They are mainly constructed of reinforced concrete and have the following specifications:

| | |
|---|---|
| Type: | Rectangular concrete tank with bucket conveyers, |
| Quantities: | 3 units, |
| Dimensions: | 2.0 m wide x 7.0 m long x 1.0 m deep/water per unit |
| Water surface: | 14 $m^2$ x 3 units = Total 42 $m^2$, |
| Appurtenances: | Inflow gates, coarse bar screens (manually operated), fine bar screens (motor-driven), grit hoisting crane, and biological-film type deodorization equipment. |

(b) Influent pump

The influent pumps are designed to lift up incoming sewage to the subsequent system. They are automatically operated with a water level meter. Their specifications are as follows:

| | |
|---|---|
| Type: | Vertically mixed flow pump, |
| Quantities: | 4 units including one standby, |
| Capacity: | 13 $m^3$/min x 400 mm-ND x 16 m-Head x 75 CV per unit, |
| Appurtenances: | Inflow sewage flow meter, maintenance crane and influent well. |

**2) Biological treatment system**

(a) RAFA reactor

The RAFA reactors are designed to decompose organic pollutants in sewage by anaerobic biological degradation. They are mainly constructed of reinforced concrete and equipped with gas-liquid-solid separators inside, which are comprised of inflow pipes, baffle plates, outflow troughs, etc. Their main specifications are as follows:

| | |
|---|---|
| Type: | Rectangular concrete tank, |
| Quantities: | 6 trains x 16 units = Total 96 units, |
| Dimensions: | 5.0 m wide x 5.0 m long x 6.0 m deep per unit, |
| Volume: | Effective 125 $m^3$ x 96 units = Total 12,000 $m^3$, |
| Appurtenances: | RAFA distribution box, distribution trough, lagoon distribution box, exhaust stacks, anaerobic sludge draw-off pumps. |

(b) Aerated lagoon

The aerated lagoons are designed to remove organic pollutants remaining in the outflow from RAFA reactors by aerobic biological purification. They are formed by earthen embankments with partial concrete revetment and equipped with submersible aerators. Main specifications are as follows:

| | |
|---|---|
| Type: | Rectangular earth pond, |
| Quantities: | 3 units, |
| Dimensions: | 39 m wide x 130 m long x 4.3 m deep per unit, |
| Volume: | Effective 13,451 $m^3$ x 3 units = Total 40,353 $m^3$, |
| Appurtenances: | Submersible aerators (5.5 kw x 15 units). |

(c) Polishing pond

The polishing ponds are designed to settle suspended solids in the outflow from aerated lagoons by gravity separation and also to digest anaerobically a part of accumulating sludge. Earthen embankments with partial concrete revetment constitute their main portions. Their specifications are as follows:

| | |
|---|---|
| Type: | Rectangular earth pond, |
| Quantities: | 3 units, |
| Dimensions: | 39 m wide x 200 m long x 4.3 m deep per unit, |
| Volume: | Effective 19,836 $m^3$ x 3 units = Total 59,508 $m^3$. |

**3) Disinfection system**

The disinfection system is designed to reduce pathogens and parasites in biologically treated sewage so as to meet the discharge standard for total coliforms. The system consists of a disinfection tank and an ultra-violet (UV) light disinfection unit, as shown below:

| | |
|---|---|
| Type: | Rectangular concrete tank, |
| Quantities: | 1 unit, |
| Dimensions: | 4.0 m wide x 10 m long x 2.5 m deep per unit, |
| Volume: | Effective 100 $m^3$ |
| Appurtenances: | UV light disinfection unit. |

**4) Treated sewage discharge system**

Finally treated sewage is discharged into the Jaboatao River through the following embedded pipes and the outfall:

| | |
|---|---|
| Design water level: | 3.01 m (+ MSL) |
| Pipe: | ND 1,200 mm x 2,900 m long |

Material: Reinforced concrete

**5) Sludge treatment system**

(a) Sludge thickener

The sludge thickener is designed to thicken the sludge generated from the biological treatment system and homogenize it. Its main portion is constructed of reinforced concrete and a motor-driven sludge collector is attached inside. Its specifications are as follows:

| | |
|---|---|
| Type: | Cylindrical Concrete tank, |
| Quantities: | 1 unit, |
| Dimensions: | 9.5 m dia. x 5.0 m deep, |
| Volume: | Effective 283 $m^3$ |
| Appurtenances: | Sludge collector. |

(b) Sludge drying bed

The sludge drying beds are designed to naturally dry the sludge generated from the biological treatment system. Their main portions are constructed of reinforced concrete and their specifications are as follows:

| | |
|---|---|
| Type: | Rectangular concrete tank, |
| Quantities: | 24 units, |
| Dimensions: | 10 m wide x 15 m long x 1.0 m deep, |
| Volume: | Effective 3,600 $m^2$, |

Dehydrated sludge quantity: 9.7 ton-Wet (60 % moisture).

**6) Electrical and control system**

All equipment in the sewage treatment station as well as all pumps in the pump stations of the Prazeres Sewerage System shall be supervised from the integrated supervisory board. This shall be installed in the administration room.

**7) Buildings and civil works**

The following building construction and civil works shall be carried out:

(a) Buildings

| | |
|---|---|
| Influent pump room: | 10 m wide x 15 m long, |
| Disinfection room: | 10 m wide x 15 m long, |
| Electrical room: | 10 m wide x 15 m long, |
| Administration building: | 25 m wide x 40 m long (one -storey) |

The administration building shall accommodate rooms such as: control room, administration room, electrical room, laboratory, staff room, workshop, storage, resting room with toilet and conference room.

(b) Civil works

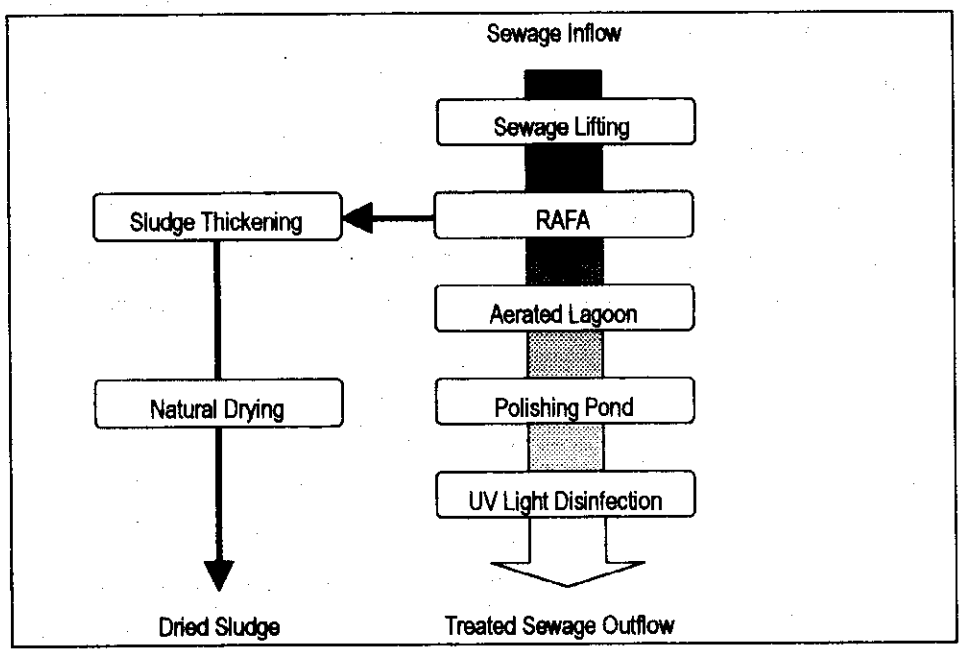
Civil works shall include miscellaneous structures in the station yard, such as: guard fence and gates, landscaping, parking lots, rainwater drainage, etc.

## 6.8 Curcurana STF

### (1) General

The Curcurana STF consists of the following steps: the "RAFA + aerated Lagoon + polishing pond" for the biological treatment system and the "natural drying" for the sludge treatment system, as shown below.

**Treatment Flow of Curcurana STF**




Treated sewage shall be discharged by gravity into the Jaboatao River through embedded discharge pipes. The sludge generated from the treatment facilities shall be disposed of at landfill sites, after being dried naturally at the STF site and transported.

The flow diagram, the hydraulic profile and the layout plan of the facilities shown in Fig. B.6-19, Fig. B.6-20 and Fig. B.6-21, respectively are the results of preliminary design.

### (2) Construction site

The site is situated at the locally determined coordinates, 2.86E / 90.92N, in the Municipality of Jaboatao. The site lies in the low-lying area of the Olho D'Agua Lagoon along the Curcurana Road. The available land area is of 9.5 ha and it belongs to a private citizen.

The land is low-lying and almost vacant at present with bushes and trees and a natural stream flows throughout it. The site faces residential zones to the east.

The ground at the site is undulated between 0.5 m and 1.0 m (+ MSL). The STF shall be constructed on the plot at a level of 3.0 m (+ MSL), which is to be prepared by reclamation to prevent the site from submersion and to discharge treated sewage by gravity.

As a result of the environmental survey in this Study, a mangrove area and its influential area with some 5 ha were identified to the north of the land proposed by the Counterpart. Therefore, the utilization of this area as the construction site of the STF was avoided.

### (3) Major facilities and structural works

#### 1) Influent system

(a) Grit chamber

The grit chambers are designed to remove coarse substances like sand by gravity separation and equipped with motor-driven bucket conveyers to remove settling materials on the bottom of the chamber. They are mainly constructed of reinforced concrete and have the following specifications:

| | |
|---|---|
| Type: | Rectangular concrete tank with bucket conveyers, |
| Quantities: | 2 units, |
| Dimensions: | 2.0 m wide x 8.0 m long x 1.0 m deep/water per unit |
| Water surface: | 16 $m^2$ x 3 units = Total 32 $m^2$, |
| Appurtenances: | Inflow gates, coarse bar screens (manually operated), fine bar screen (motor-driven), grit hoisting crane and biological-film type deodorization equipment. |

(b) Influent pump

The influent pumps are designed to lift up incoming sewage to the subsequent system. They are automatically operated with a water level meter. Their specifications are as follows:

| | |
|---|---|
| Type: | Vertically mixed flow and axial pump, |
| Quantities: | 3 units including one standby, |

| | |
|---|---|
| Capacity: | 14.5 $m^3$/min x 400 mm-ND x 16 m-Head x 75 CV per unit, |
| Appurtenances: | Inflow sewage flow meter, maintenance crane and influent well. |

**2) Biological treatment system**

(a) RAFA reactor

The RAFA reactors are designed to decompose organic pollutants in sewage by anaerobic biological degradation. They are mainly constructed of reinforced concrete and equipped with gas-liquid-solid separators inside, which are comprised of inflow pipes, baffle plates, outflow troughs, etc. Their main specifications are as follows:

| | |
|---|---|
| Type: | Rectangular concrete tank, |
| Quantities: | 6 trains x 12 units = Total 72 units, |
| Dimensions: | 5.0 m wide x 5.0 m long x 6.0 m deep per unit, |
| Volume: | Effective 125 $m^3$ x 72 units = Total 9,000 $m^3$, |
| Appurtenances: | RAFA distribution box, distribution trough, lagoon distribution box, exhaust stacks, anaerobic sludge draw-off pumps. |

(b) Aerated lagoon

The aerated lagoons are designed to remove organic pollutants remaining in the outflow from RAFA reactors by aerobic biological purification. They are formed by earthen embankments with partial concrete revetment and equipped with submersible aerators. Main specifications are as follows:

| | |
|---|---|
| Type: | Rectangular earth pond, |
| Quantities: | 2 units, |
| Dimensions: | 50 m wide x 115 m long x 4.3 m deep per unit, |
| Volume: | Effective 16,181 $m^3$ x 2 units = Total 32,362 $m^3$, |
| Appurtenances: | Submersible aerators (5.5 kw x 10 units). |

(c) Polishing pond

The polishing ponds are designed to settle suspended solids in the outflow from aerated lagoons by gravity separation and also to digest anaerobically a part of accumulating sludge. Earthen embankments with partial concrete revetment constitute their main portions. Their specifications are as follows:

| | |
|---|---|
| Type: | Rectangular earth pond, |

| | |
|---|---|
| Quantities: | 2 units, |
| Dimensions: | 50 m wide x 166 m long x 4.3 m deep per unit, |
| Volume: | Effective 22,464 $m^3$ x 2 units = Total 44,928 $m^3$. |

### 3) Disinfection system

The disinfection system is designed to reduce pathogens and parasites in biologically treated sewage so as to meet the discharge standard for total coliforms. The system consists of a disinfection tank and an ultra-violet (UV) light disinfection unit, as shown below:

| | |
|---|---|
| Type: | Rectangular concrete tank, |
| Quantities: | 1 unit, |
| Dimensions: | 3.0 m wide x 10 m long x 2.5 m deep per unit, |
| Volume: | Effective 75 $m^3$ |
| Appurtenances: | UV light disinfection unit. |

### 4) Treated sewage discharge system

Finally treated sewage is discharged into the Jaboatao River through the following embedded pipes and the outfall:

| | |
|---|---|
| Design water level: | 1.36 m (+ MSL) |
| Pipe: | ND 1,000 mm x 1,600 m long |
| Material: | Reinforced concrete |

### 5) Sludge treatment system

(a) Sludge thickener

The sludge thickener is designed to thicken the sludge generated from the biological treatment system and homogenize it. Its main portion is constructed of reinforced concrete and a motor-driven sludge collector is attached inside. Its specifications are as follows:

| | |
|---|---|
| Type: | Cylindrical concrete tank, |
| Quantities: | 1 unit, |
| Dimensions: | 8.0 m dia. x 5.0 m deep, |
| Volume: | Effective 201 $m^3$ |
| Appurtenances: | Sludge collector. |

(b) Sludge drying bed

The sludge drying beds are designed to naturally dry the sludge generated from the biological treatment system. Their main portions are constructed of reinforced concrete and their specifications are as follows:

| | |
|---|---|
| Type: | Rectangular concrete tank, |
| Quantities: | 14 units, |
| Dimensions: | 10 m wide x 15 m long x 1.0 m deep, |
| Volume: | Effective 2,100 $m^2$, |

Dehydrated sludge quantity: 5.8 ton-Wet (60 % moisture).

**6) Electrical and control system**

All equipment in the sewage treatment station as well as all pumps in the pump stations of the Curcurana Sewerage System shall be supervised from the integrated supervisory board. This shall be installed in the administration room.

**7) Buildings and civil works**

The following building construction and civil works shall be carried out:

(a) Buildings

| | |
|---|---|
| Influent pump room: | 10 m wide x 10 m long, |
| Disinfection room: | 10 m wide x 12 m long, |
| Electrical room: | 10 m wide x 12 m long, |
| Administration building: | 25 m wide x 36 m long (one-storey) |

The administration building shall accommodate rooms such as: control room, administration room, electrical room, laboratory, staff room, workshop, storage, resting room with toilet and conference room.

(b) Civil works

Civil works shall include miscellaneous structures in the station yard, such as: guard fence and gates, landscaping, parking lots, rainwater drainage, etc.

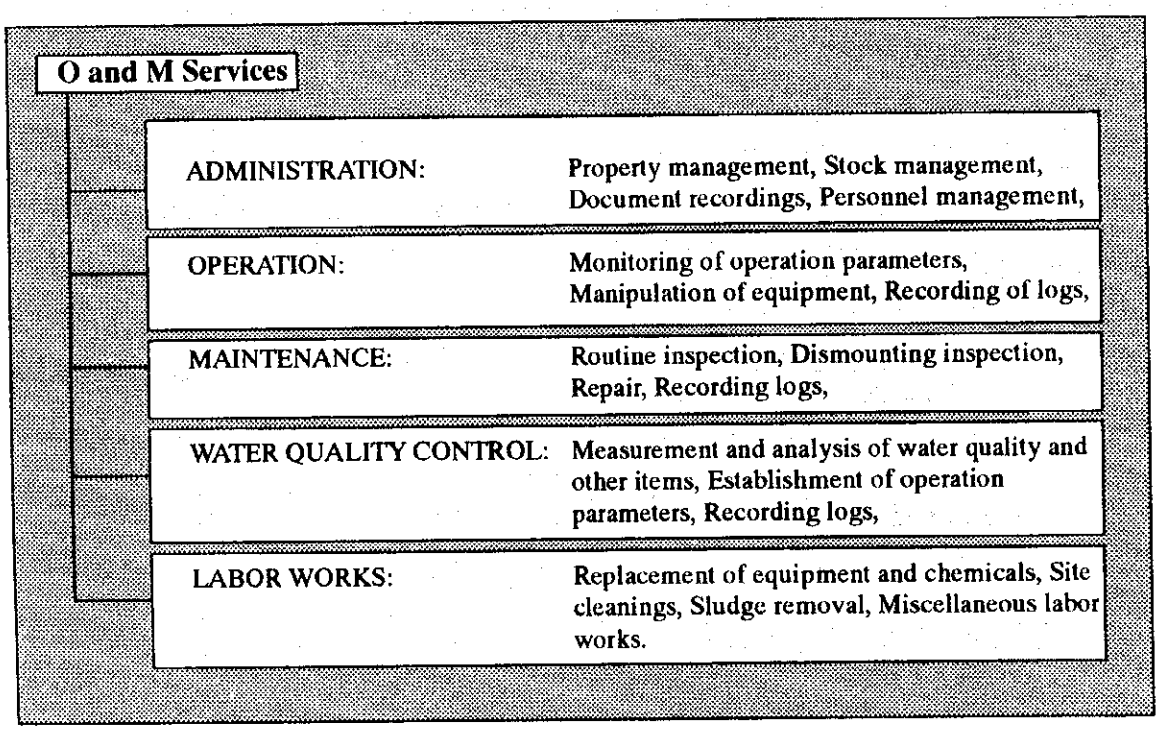
# 7. REQUIRED O&M ITEMS FOR PRIORITY STF

## 7.1 Operation and Maintenance Services

### (1) General

The services of operation and maintenance for sewage treatment facilities may be subdivided into administration, operation, maintenance, water quality control and labor works. Their respective works are shown in the following table:

**Classification of Operation and Maintenance Services**




### (2) Administration service

Administrative service includes the management of properties and stock, budgeting and accounting, and personnel management. In addition, security guards, building janitors, and cleaning persons are managed by an administrative unit.

### (3) Operation service

The operation service is composed of the monitoring of operation parameters and the manipulation of equipment such as pumps, gates, valves, etc. The monitoring of facilities is required continuously without ceasing to command the operation status of the facilities. Therefore, it is proposed that the monitoring takes place by the introduction of a centralized and automatic monitoring system. The operation to manipulate equipment, on the other

hand, will be reduced to a minimum, since it requires high construction costs and is not reliable without periodical and precise adjustment/maintenance.

Table B.7-1 shows major operation parameters for the respective STFs. Of these, some items shall be supervised from the supervision board, if it is possible technically.

### (4) Maintenance service

To maintain proper and sustainable functions/performance of component facilities over a specified duration, routine and periodical inspections of mechanical and electrical/instrumental equipment are most important. The following table shows required maintenance items in STFs, classified into daily, monthly and yearly activities.

**Required Maintenance Items**

| Frequency | Categories | Maintenance Items |
|---|---|---|
| Daily | Mechanical | Appearance |
| | | Unusual vibration and sound |
| | | Lubricants |
| | Electrical and Instruments | Appearance |
| | | Unusual vibration and sound |
| | | Overheating |
| | | Current |
| Monthly | Mechanical | Gland packing's wear and leakage |
| | | Checking and replacement of lubricants |
| | | Checking of chains and belts |
| | Electrical and Instruments | Checking of insulation |
| | | Adjustment of instruments |
| Yearly | Mechanical | Dredging RAFA Reactor |
| | | Drying up tanks and checking of submersible parts |
| | | Drying up aerated lagoons and polishing ponds, and dredging, if necessary |
| | | Drying up bio-filters and sedimentation tanks, and internal checking |
| | | Overhaul of main equipment |
| | | Replacement of lubricants |
| | | Replacement of gland packings |
| | | Replacement of chains and belts |
| | | Tightening of bolts |
| | Electrical and Instruments | Checking sequential operation |
| | | Checking protective operation |

### (5) Water quality control

Water quality control is one of the most important services to ensure the treatment performance of STFs. The main task in water quality control is to analyze the operation status from the physical, chemical and biological points of view. Major items to be

measured and analyzed are shown in the following table. The results shall be used for the adjustment and resetting the operation conditions of STFs.

**Required Measurement and Analysis Items for Water Quality**

| Sampling Points | Frequency | Measurement and Analysis Items | Remarks |
|---|---|---|---|
| Influent well | Daily | Appearance, Odor, Water temperature, Turbidity, pH | Incoming sewage |
| | Weekly | SS, COD | |
| | Monthly | BOD, $NH_4$-N | |
| RAFA Outlet | Daily | Appearance, Odor, Water temperature, Turbidity, pH | RAFA outflow |
| | Weekly | SS, COD | |
| | Monthly | BOD, $NH_4$-N | |
| Outlet of aerated Lagoons | Daily | Appearance, Odor, Water temperature, Turbidity, pH, DO | Aerated lagoon outflow |
| Outlet of disinfection tank | Daily | Appearance, Odor, Water temperature, Turbidity, pH | Discharged sewage |
| | Weekly | SS, COD, Total-Coliform | |
| | Monthly | BOD, $NH_4$-N, $NO_3$-N | |
| Outlet of bio-filters | Daily | Appearance, Odor, Water temperature, Turbidity, pH | Bio-filter outflow |
| Outlet of thickener | Daily | Appearance, Odor | Thickened sludge |
| | Weekly | Sludge concentration | |
| Sludge drying beds | Daily | Appearance, Odor | Dried sludge |
| | Weekly | Moisture of dried sludge | |
| Outlet of sludge digester | Daily | Appearance, Odor | Digested sludge |
| | Weekly | Sludge concentration | |
| | Daily | Appearance, Odor | Supernatant |
| | Weekly | SS | |
| Outlet of dehydrators | Daily | Appearance, Odor | Dehydrated sludge |
| | Weekly | Moisture of dried sludge | |

### (6) Labor works

Labor works are manual work to assist site works such as the replenishing of chemicals, site cleaning, dismounting of equipment, grit and sludge removal, manual operations of gates, dredging of tanks, etc.

## 7.2 Equipment for Operation and Maintenance

Ordinary maintenance vehicles/equipment and tools such as mechanical shovel cars, forklift trucks, welding machines, lathe, lifting hoists, etc. shall be provided in the stations to repair parts and transport goods and sludge. In addition, the following apparatus necessary for the daily and weekly measurement and analysis of water quality shall be provided:

- Temperature meters,
- PH meters,
- Conductivity meters,
- DO meters,

- COD analysis apparatus,
- Turbidity meters,
- Stereo-microscope,
- Digital balance,
- Drying oven,
- Incubator,
- Flocculation test kit,
- Hot plate stirrers,
- Vacuum pumps,
- Water bath,
- Distillation kit,
- Continuous deionizer unit, and
- Miscellaneous instruments, consumables and spares for measurement and analysis.

**Table B.1-1 Existing Sewerage System besides Four Major Systems in RMR**

| No. | Locations | Covered Area (ha) | Number of Connections | Served Population (People) |
|---|---|---|---|---|
| 1 | Morada Capibaribe | 0.74 | 112 | 504 |
| 2 | Felipe Camarao | 11 | 608 | 2,736 |
| 3 | Inez Andreazza | 29.8 | 2464 | 11,088 |
| 4 | Conj. Mal. Castelo Branco | 5.0 | 640 | 2,880 |
| 5 | Vinicius de Moraes | 8.9 | 105 | 472 |
| 6 | Conj.Resid. Bosque da Torre | 2.2 | 400 | 1,800 |
| 7 | Conj.Hab.Lagoa Encantada | 26.7 | 900 | 4,050 |
| 8 | Conj.Res.Vila Coimbra | 0.91 | 126 | 567 |
| 9 | COMAR-Hosp.Aeronautica | 168 | 570 | 2,565 |
| 10 | Residencial Torre/Banorte | 17.5 | 1552 | 6,984 |
| 11 | Conj.Res.Primavera | 15.4 | 400 | 1,800 |
| 12 | IPSEP | 168 | 548 | 2,466 |
| 13 | Jardim Petropolis | 2 | 320 | 1,440 |
| 14 | San Martim | 13.6 | 711 | 3,200 |
| 15 | UR-1 | 27.7 | 1201 | 5,405 |
| 16 | UR-2 | 29.9 | 1072 | 4,824 |
| 17 | UR-3 | 18.8 | 847 | 3,812 |
| 18 | UR-4 | 7.8 | 352 | 1,584 |
| 19 | UR-5 | 21.9 | 905 | 4,073 |
| 20 | UR-7 | 15.8 | 551 | 2,479 |
| 21 | UR-10 | 19 | 1222 | 5,499 |
| 22 | Conj.Res.Universitario | 2.9 | 320 | 1,440 |
| 23 | Conj.Res.Joao Paulo II | 7.1 | 672 | 3,024 |
| 24 | Loteamento Apipucos | 14 | 135 | 608 |
| 26 | Residencial Conj.Portinari | 0.75 | 120 | 540 |
| 27 | Engenho do Meio | 70 | 1744 | 7,848 |
| 28 | Cordeiro | 26 | 515 | 2,318 |
| 29 | Conj.Res.Santa Luzia | 2.0 | 192 | 864 |
| 30 | Areias | 165 | 4005 | 18,023 |
| 31 | Loteamento Ipiranga | 11 | 234 | 1,053 |
| Total | | 635 | 23,543 | 105,943 |

Source: Updated based on the PQA RE-01.

## Table B.1-2 Existing Condominial Sewerage Systems in RMR

| No. | Locations | Served Area (ha) | Number of Connection | Served Population (people) |
|---|---|---|---|---|
| 1 | Joao Xavier Pedrosa | 2.1 | 91 | 409 |
| 2 | Alderico Pereira Rego | 0.3 | 10 | 45 |
| 3 | Jardim Beberibe | 2.0 | 39 | 175 |
| 4 | Vila Jorge Pimenta | 9.0 | 499 | 2,245 |
| 5 | Nova Trento | 0.6 | 17 | 76 |
| 6 | Cajueiro | 10 | 52 | 234 |
| 7 | Vila Burity | 8.0 | 269 | 1,210 |
| 8 | Abdias de Oliveira | 1.6 | 118 | 531 |
| 9 | Ind. Paulo Alimonda | 1.4 | 25 | 112 |
| 10 | Rio Jiquiá | 0.7 | 31 | 139 |
| 11 | Elpidio Branco | 2.1 | 90 | 405 |
| 12 | Skylab II | 4.2 | 135 | 607 |
| 13 | Brasilandia | 2.2 | 63 | 283 |
| 14 | Ruth Moura | 0.5 | 19 | 85 |
| 15 | Avare/Tupinare | 3.0 | 120 | 540 |
| 16 | Jardim Sao Paulo | 8.0 | 141 | 634 |
| 17 | Olegario Mariano | 2.0 | 39 | 175 |
| 18 | Jose da Bomba | 4.0 | 144 | 648 |
| 19 | Vila Sao Miguel | 21 | 828 | 3,726 |
| 20 | Vila Cardeal Silva | 13 | 423 | 1,903 |
| 21 | Vietnan | 12 | 753 | 3,388 |
| 22 | Vila N.Sra de Fatima | 0.2 | 23 | 103 |
| 23 | Coque 1-Ibipora | 8.0 | 675 | 3,037 |
| 24 | Coque 2-M.Luther King | 9.4 | 1,029 | 4,630 |
| 25 | Coque 3-Realeza | 0.9 | 142 | 639 |
| 26 | Coque 4-Av.Central | 3.5 | 326 | 1,467 |
| 27 | Coelhos | 11.2 | 1,051 | 4,729 |
| 28 | Joao de Barros | 1.8 | 340 | 1,530 |
| 29 | Alto Santa Isabel | 55.2 | 3,120 | 14,040 |
| 30 | Vila Tamarineira | 1.6 | 175 | 787 |
| 31 | Apipucos/Caetes | 4.9 | 345 | 1,552 |
| 32 | Cacimbao | 1.6 | 150 | 675 |
| 33 | Vila Santa Luzia | 38.5 | 2,141 | 9,634 |
| 34 | Barbalho | 12 | 798 | 3,591 |
| 35 | Vila Santa Marta | 1.2 | 218 | 981 |
| 36 | Coronel Fabriciano | 1.9 | 87 | 391 |
| 37 | Entra Apulso | 0.7 | 34 | 153 |
| 38 | Vila Teimosinho | 1.8 | 147 | 661 |
| 39 | Bomba Grande | 5.1 | 219 | 985 |
| 40 | Skylab I | 5.4 | 313 | 1,408 |
| 41 | Poco Alto | 2.7 | 266 | 1,197 |
| 42 | Odete Monteiro | 0.4 | 55 | 247 |
| 43 | Aritana | 0.3 | 38 | 171 |
| 44 | Lot.Mel.Gonçalves da Luz | 0.5 | 55 | 247 |
| 45 | Roda de Fogo | 54 | 3,100 | 13,950 |
| 46 | Conj.27 de Novembro | 90 | 2,465 | 11,092 |
| 47 | Sesi | 11.9 | 642 | 2,889 |
| 48 | Tancredo Neves | 1.4 | 137 | 616 |
| 49 | Ponte do Maduro | 36 | 1,120 | 5,040 |
| 50 | Passarinho | 9.8 | 580 | 2,610 |
| 51 | Burity | 25.6 | 1,562 | 7029 |
| 52 | Ambole | 4.1 | 269 | 1,210 |
| 53 | Brasilit | 4.2 | 397 | 1,786 |
| 54 | Pe.Henrique | 5.8 | 138 | 621 |
| **Total** | | **519** | **26,063** | **117,283** |

Source: PQA RE-04 (1998)

## Table B.1-3 Ongoing Sewerage Projects Managed by Municipalities

| Municipalities | Sewerage Systems | Financial Resources | Projects' Data | |
|---|---|---|---|---|
| | | | Components | Project Cost (R$) |
| Cabo de Santo Agostinho | Curcurana | | Collector and Treatment Station | 552,000 |
| | Ponte dos Carvalhos and Gaibu/Suape | PRODETUR BNDES + BIRD | Collector and Treatment Station | 5,000,000 |
| | Parque Pirapama and Charnequinha | CEF | Collector and Treatment Station | Unknown |
| Igarassu | Igarassu 2 | PRO-MORADIA CEF | Collector and Treatment Station | 900,000 |
| | Igarassu 2 | PROJETO BEIRA MAR I | Collector and Treatment Station | 2,000,000 |
| Jaboatao dos Guararapes | Prazeres | | Collector and Treatment Station | 3,327,754 |
| Moreno | Moreno 1 | | Collector and Treatment Station (RAFA+ Biofilter) | 3,732,052 |
| | Moreno 2 | | | 1,584,431 |
| | Moreno 3 | | | 1,061,975 |
| | Bonanca | | | 1,740,701 |
| Paulista | Janga | CEF – PASS | Collector and Treatmen Station t, Sanitation Education | 366,942 |
| Recife | Cabanga | CEF | Collector, Interceptor and Treatment Station (for ETE Cabanga) | Unknown |
| | Peixinhos | | Collector for ZEIS Jorge Pimenta and EE + Emissary (for ETE Peixinhos) | 455,800 |
| | Imbiribeira | | Collector and Treatment Station (for ETE Ignes Andreazza) | 613,904<br>166,507 |
| | Cabanga | | Collector | 278,426<br>834,829 |
| Sao Lourenco da Mata | Sao Lourenco 2 | CEF | Collector and Treatment Station (RAFA) | 285,810 |
| | Sao Lourenco 2 | CEF | Collector and Treatment Station (3 septic tanks and filters) | 78,837 |
| Total | | | | 1,477,902 |

Source: PQA RE-04 (1998)

## Table B.2-1 Baisc Scheme of Sewerage Development (1/2)

| No. | Sewerage Systems | Sewage Collection Facilities | | | Sewage Treatment Facilities | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | Development of Facilities | | Rehabilitation of Existing Facilities | Development of Facilities | | | Rehabilitation of Existing Facilities | |
| | | New Installation | Additional Installation | | New Installation | Additional Installation | Installation of Disinfection System | | |
| 1 | Caetes | | ● | ● | | ● | ● | ● | |
| 2 | Peixinhos | | ● | ● | | ● | ● | ● | |
| 3 | Caixa D'agua | ● | | | ● | | ● | | |
| 4 | Nova Descoberta | ● | | | ● | | ● | | |
| 5 | Aguazinha | | ● | ● | ● | | ● | | |
| 6 | Dois Unidos | | ● | ● | ● | | ● | | |
| 7 | Ponte dos Carvalhos | ● | | | ● | | ● | | |
| 8 | Charnequinha | ● | | | ● | | ● | | |
| 9 | Camaragibe/Recife 1 | | ● | ● | ● | | ● | | |
| 10 | Camaragibe/Recife 2 | ● | | | ● | | ● | | |
| 11 | Camaragibe 1 | | ● | ● | ● | | ● | | |
| 12 | Camaragibe 2 | ● | | | ● | | ● | | |
| 13 | Cabanga | | ● | ● | | ● | ● | ● | |
| 14 | Cordeiro | | ● | ● | ● | ● | ● | ● | The existing ETEC-08 will be used as another system after modification, separately from the main Subsystem. |
| 15 | Caxanga | | ● | ● | ● | | ● | | |
| 16 | Igarassu 2 | ● | | | ● | | ● | | |
| 17 | Ipojuca - Sede | ● | | | ● | | ● | | |
| 18 | Itapissuma 1 | | ● | ● | ● | | ● | | |
| 19 | Itapissuma 2 | ● | | | ● | | ● | | |
| 20 | Comportas | ● | | | ● | | ● | | |
| 21 | Curcurana | | ● | ● | ● | ● | ● | ● | The existing ETEC-03 and ETEC-09 will be used as another systems after rehabilitation, separately from the main Subsystem. |
| 22 | Prazeres | | ● | ● | ● | ● | ● | ● | The existing ETEC-02 will be used as another system after modification, separately from the main Subsystem. |
| 23 | Jaboatao 1 | | ● | ● | ● | | ● | | |
| 24 | Jaboatao 2 | ● | | | ● | | ● | | |
| 25 | Ibura de Cima | | ● | ● | ● | | ● | | |
| 26 | Jaboatao 3 | ● | | | ● | | ● | | |

## Table B.2-1 Baisc Scheme of Sewerage Development (2/2)

| No. | Sewerage Systems | Sewage Collection Facilities | | | Sewage Treatment Facilities | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | Development of Facilities | | Rehabilitation of Existing Facilities | Development of Facilities | | | Rehabilitation of Existing Facilities | |
| | | New Installation | Additional Installation | | New Installation | Additional Installation | Installation of Disinfection System | | |
| 27 | Bonanca | ● | | | ● | | ● | | |
| 28 | Moreno 1 | ● | | | ● | | ● | | |
| 29 | Moreno 2 | | ● | ● | | ● | ● | ● | |
| 30 | Moreno 3 | ● | | | ● | | ● | | |
| 31 | Camaragibe 3 | | ● | ● | ● | | ● | | |
| 32 | Sao Lourenco 1 | | ● | ● | ● | | ● | | |
| 33 | Sao Lourenco 2 | ● | | | ● | | ● | | |
| 34 | Boa Viagem | | ● | ● | ● | | ● | | |
| 35 | Imbiribeira | | ● | ● | ● | | ● | | |
| 36 | Jardim Sao Paulo | | ● | ● | ● | | ● | | |
| 37 | Ibura de Baixo | | ● | ● | ● | | ● | | |
| 38 | Ignes Andreazza | | ● | ● | | | ● | ● | Only the rehabilitation and the installation of disinfection system will take place for the STF. |
| 39 | Mangueira | | ● | ● | | ● | ● | ● | |
| 40 | Roda de Fogo | | ● | ● | ● | | ● | ● | |
| 41 | Janga | | ● | ● | | ● | ● | ● | |
| 42 | Paulista | | ● | ● | | ● | ● | ● | |
| 43 | Conceicao | | ● | ● | ● | | ● | | |
| 44 | Apipucos | ● | | | ● | | ● | | |
| 45 | Curado | | ● | ● | | ● | ● | ● | |
| 46 | P.P. de Galinhas | ● | | | ● | | ● | | |
| 47 | Jardim Paulista | | ● | ● | | ● | ● | ● | |
| 48 | Mirueira | | ● | ● | ● | | ● | | |
| 49 | Mutirao | | ● | ● | | ● | ● | ● | |
| 50 | Nova Cruz | ● | | | ● | | ● | | |
| 51 | Parque Capibaribe | | ● | ● | | ● | ● | ● | |
| 52 | Parque Pirapama | | ● | ● | | ● | ● | ● | |
| 53 | Vila Burity | | ● | ● | | ● | ● | ● | |
| 54 | Vila dos Milagres | | ● | ● | | ● | ● | ● | |
| 55 | 27 de Novembro | | ● | ● | | ● | ● | ● | |

Source: JICA Study Team

Note: The columns marked by " ● " means that the corresponding work items are implemented for respective systems.

## Table B.2-2 Basic Planning Data of Sewerage Systems (1/2)

| No. | Sewerage Systems | Population in 2020 (people) | Sewerage Area | | Capacity of Existing Treatment Facilities ($m^3$/day) | Sewage Flow in 2020 ($m^3$/day) | | | BOD (mg/l) | SS (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sewerage Area in 2020 (ha) | Area covered by Existing System (ha) | | Daily Average | Daily Max. | Hourly Max. | | |
| 1 | Caetes | 60,779 | 884.5 | 705.1 | 8,900 | 11,014 | 12,395 | 16,682 | 299 | 332 |
| 2 | Peixinhos | 398,839 | 2,548.2 | 963.2 | 36,000 | 57,279 | 66,980 | 95,111 | 370 | 411 |
| 3 | Caixa D'agua | 35,305 | 454.7 | - | - | 5,134 | 5,868 | 7,820 | 371 | 413 |
| 4 | Nova Descoberta | 65,506 | 386.9 | - | - | 7,138 | 8,456 | 11,849 | 496 | 551 |
| 5 | Aguazinha | 59,005 | 372.6 | 2.7 | - | 6,569 | 7,775 | 10,858 | 485 | 539 |
| 6 | Dois Unidos | 63,495 | 422.9 | 23.6 | - | 8,243 | 9,675 | 13,600 | 416 | 462 |
| 7 | Ponte dos Carvalhos | 24,365 | 131.7 | - | - | 3,615 | 4,224 | 6,051 | 364 | 404 |
| 8 | Charnequinha | 15,096 | 66.5 | - | - | 2,174 | 2,552 | 3,684 | 375 | 417 |
| 9 | Camaragibe/Recife 1 | 61,043 | 954.4 | 80.4 | - | 11,254 | 12,722 | 17,022 | 293 | 325 |
| 10 | Camaragibe/Recife 2 | 16,477 | 268.7 | - | - | 3,220 | 3,642 | 4,882 | 276 | 307 |
| 11 | Camaragibe 1 | 24,870 | 446.3 | 89.3 | - | 4,450 | 4,952 | 6,464 | 302 | 335 |
| 12 | Camaragibe 2 | 26,107 | 246.3 | - | - | 3,380 | 3,906 | 5,327 | 417 | 463 |
| 13 | Cabanga | 304,394 | 2,260.4 | 1,799.4 | 80,000 | 55,239 | 64,163 | 91,362 | 314 | 348 |
| 14 | Cordeiro | 100,048 | 675.3 | 129.2 | 4,416 | 16,319 | 18,995 | 27,034 | 331 | 368 |
| 15 | Caxanga | 37,326 | 508.9 | 31.3 | - | 6,690 | 7,624 | 10,337 | 301 | 335 |
| 16 | Igarassu 2 | 50,251 | 816.7 | - | - | 9,690 | 10,906 | 14,595 | 280 | 311 |
| 17 | Ipojuca - Sede | 17,856 | 105.4 | - | - | 2,687 | 3,134 | 4,473 | 359 | 399 |
| 18 | Itapissuma 1 | 10,679 | 101.7 | 20.8 | - | 1,614 | 1,828 | 2,522 | 357 | 397 |
| 19 | Itapissuma 2 | 10,416 | 99.2 | - | - | 1,574 | 1,783 | 2,460 | 357 | 397 |
| 20 | Comportas | 49,970 | 487.1 | - | - | 8,275 | 9,545 | 13,265 | 326 | 362 |
| 21 | Curcurana | 123,636 | 909.9 | 46.2 | 4,975 | 21,280 | 24,678 | 35,051 | 314 | 349 |
| 22 | Prazeres | 233,403 | 1,547.7 | 71.5 | 1,625 | 32,581 | 38,122 | 53,840 | 387 | 430 |
| 23 | Jaboatao 1 | 45,472 | 396.2 | 151.2 | - | 5,956 | 6,865 | 9,442 | 412 | 458 |
| 24 | Jaboatao 2 | 56,231 | 803.3 | - | - | 9,656 | 10,780 | 14,435 | 314 | 349 |
| 25 | Ibura de Cima | 51,984 | 321.9 | 153.3 | - | 6,097 | 7,137 | 10,010 | 460 | 512 |
| 26 | Jaboatao 3 | 36,974 | 528.2 | - | - | 6,349 | 7,088 | 9,492 | 314 | 349 |
| 27 | Bonanca | 5,025 | 114.2 | - | - | 1,046 | 1,147 | 1,473 | 259 | 288 |
| 28 | Moreno 1 | 18,792 | 208.8 | - | - | 2,969 | 3,345 | 4,566 | 342 | 380 |
| 29 | Moreno 2 | 6,435 | 71.5 | 32.6 | 854 | 1,017 | 1,145 | 1,564 | 342 | 380 |

## Table B.2-2 Basic Planning Data of Sewerage Systems (2/2)

| No. | Sewerage Systems | Population in 2020 (people) | Sewerage Area | | Capacity of Existing Treatment Facilities ($m^3$/day) | Sewage Flow in 2020 ($m^3$/day) | | | BOD (mg/l) | SS (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sewerage Area in 2020 (ha) | Area covered by Existing System (ha) | | Daily Average | Daily Max. | Hourly Max. | | |
| 30 | Moreno 3 | 3,465 | 38.5 | - | - | 547 | 617 | 842 | 342 | 380 |
| 31 | Camaragibe 3 | 30,238 | 621.8 | 150.9 | - | 5,967 | 6,599 | 8,555 | 274 | 304 |
| 32 | Sao Lourenco 1 | 45,783 | 921.7 | 298.9 | - | 9,619 | 10,737 | 14,115 | 257 | 286 |
| 33 | Sao Lourenco 2 | 33,288 | 652.7 | - | - | 6,981 | 7,813 | 10,309 | 258 | 286 |
| 34 | Boa Viagem | 159,314 | 1,281.3 | 152.1 | - | 27,794 | 32,113 | 45,402 | 311 | 346 |
| 35 | Imbiribeira | 56,497 | 550.4 | 168.2 | - | 10,103 | 11,627 | 16,251 | 302 | 336 |
| 36 | Jardim Sao Paulo | 56,102 | 497.1 | 104.6 | - | 8,384 | 9,723 | 13,511 | 375 | 416 |
| 37 | Ibura de Baixo | 179,179 | 1,399.9 | 93.9 | - | 23,557 | 27,391 | 38,075 | 406 | 451 |
| 38 | Ignes Andreazza | 6,579 | 47.4 | 37.9 | 2,217 | 988 | 1,148 | 1,620 | 360 | 400 |
| 39 | Mangueira | 42,642 | 285.8 | 112.8 | 3,732 | 6,430 | 7,505 | 10,641 | 363 | 403 |
| 40 | Roda de Fogo | 27,810 | 170.8 | 144.6 | 4,752 | 3,892 | 4,564 | 6,477 | 386 | 429 |
| 41 | Janga | 316,075 | 2,878.7 | 1,105.7 | 34,214 | 59,891 | 68,821 | 97,013 | 285 | 317 |
| 42 | Paulista | 68,930 | 783.3 | 345.2 | 6,750 | 11,052 | 12,460 | 16,997 | 337 | 374 |
| 43 | Conceicao | 62,445 | 709.6 | 50.0 | - | 12,515 | 14,281 | 19,888 | 269 | 299 |
| 44 | Apipucos | 10,339 | 129.7 | - | - | 2,076 | 2,374 | 3,281 | 279 | 311 |
| 45 | Curado | 18,626 | 102.5 | 102.5 | 7,021 | 2,031 | 2,414 | 3,399 | 495 | 550 |
| 46 | P.P. de Galinhas | 3,705 | 49.4 | - | - | 621 | 695 | 936 | 322 | 358 |
| 47 | Jardim Paulista | 24,851 | 282.4 | 282.4 | 3,085 | 3,954 | 4,451 | 6,066 | 339 | 377 |
| 48 | Mirueira | 34,009 | 401.5 | 401.5 | - | 5,478 | 6,169 | 8,386 | 335 | 372 |
| 49 | Mutirao | 6,380 | 72.5 | 65.3 | 1,700 | 1,334 | 1,525 | 2,132 | 258 | 287 |
| 50 | Nova Cruz | 5,244 | 92.0 | - | - | 1,053 | 1,184 | 1,577 | 269 | 299 |
| 51 | Parque Capibaribe | 23,475 | 460.3 | 425.2 | 2,735 | 4,923 | 5,510 | 7,270 | 258 | 286 |
| 52 | Parque Pirapama | 32,794 | 172.6 | 51.8 | 3,060 | 4,845 | 5,665 | 8,124 | 366 | 406 |
| 53 | Vila Burity | 11,397 | 68.1 | 20.5 | 1,250 | 1,350 | 1,578 | 2,220 | 456 | 507 |
| 54 | Vila dos Milagres | 14,289 | 99.4 | 99.4 | 1,853 | 1,853 | 2,139 | 2,994 | 416 | 463 |
| 55 | 27 de Novembro | 9,369 | 48.6 | 3.2 | 963 | 963 | 1,150 | 1,620 | 525 | 584 |
| Total of 55 Systems | | 3,292,602 | 29,958 | 8,516 | 210,102 | 530,710 | 611,682 | 852,970 | 336 | 374 |

Source: JICA Study Team

## Table B.2-3 Development Works of Sewage Collection Facilities (1/2)

| No. | Sewerage Systems | Basic Planning Conditions | | | Sewers | | | | | | | Pump Stations | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Trunk and Pressure Sewers | | | | | |
| | | Sewerage Area in 2020 (ha) | Existing Sewerage Area (ha) | Hourly Maximum Sewage Flow in 2020 ($m^3$/day) | Condom. Collectors (km) | Conven-tional Collectors (km) | Branch Sewers (km) | Maximum Diameter of Pipes (mm) | Length of Trunk Sewers (km) | Length of Pressure Sewers (km) | Total Length (km) | Quantities of Pumps (set) | Motor Power (CV) |
| 1 | Caetes | 884.5 | 705.1 | 16,682 | - | 32.3 | 16.6 | 350 | 2.2 | 0.4 | 51.5 | 3 | 4.9 |
| 2 | Peixinhos | 2,548.2 | 963.2 | 95,111 | 89.3 | 151.4 | 157.4 | 700 | 2.5 | 1.2 | 401.7 | 12 | 164.6 |
| 3 | Caixa D'agua | 454.7 | - | 7,820 | 23.7 | 46.4 | 43.1 | 500 | 2.5 | 1.1 | 116.7 | 12 | 141.1 |
| 4 | Nova Descoberta | 386.9 | - | 11,849 | 37.5 | 13.5 | 38.0 | 700 | 2.1 | 1.8 | 92.9 | 18 | 200.8 |
| 5 | Aguazinha | 372.6 | 2.7 | 10,858 | 41.7 | 4.0 | 34.8 | 500 | 2.2 | 1.5 | 84.3 | 24 | 228.6 |
| 6 | Dois Unidos | 422.9 | 23.6 | 13,600 | 26.1 | 32.7 | 39.9 | 500 | 0.8 | 2.4 | 101.9 | 15 | 145.1 |
| 7 | Ponte dos Carvalhos | 131.5 | - | 6,051 | - | 23.7 | 12.2 | 400 | 1.0 | 0.7 | 37.5 | 6 | 51.1 |
| 8 | Charnequinha | 66.5 | - | 3,684 | - | 12.0 | 6.7 | 300 | - | 0.4 | 19.0 | 3 | 29.7 |
| 9 | Camaragibe/Recife 1 | 955.0 | 80.4 | 17,022 | 14.6 | 135.6 | 86.0 | 900 | 1.5 | 2.7 | 240.3 | 15 | 478.4 |
| 10 | Camaragibe/Recife 2 | 268.7 | - | 4,882 | 4.5 | 41.7 | 26.6 | 500 | 0.3 | 0.1 | 73.1 | 3 | 24.5 |
| 11 | Camaragibe 1 | 446.3 | 89.3 | 6,464 | 3.7 | 58.7 | 35.7 | 500 | - | 0.1 | 98.2 | 3 | 59.0 |
| 12 | Camaragibe 2 | 246.3 | - | 5,327 | 9.1 | 30.7 | 24.6 | 400 | - | 0.0 | 64.4 | 3 | 46.1 |
| 13 | Cabanga | 2,260.4 | 1,799.4 | 91,362 | 19.9 | 53.1 | 46.1 | 300 | - | 0.1 | 119.2 | 3 | 35.4 |
| 14 | Cordeiro | 675.3 | 129.2 | 27,034 | 19.7 | 68.7 | 51.0 | 700 | 5.4 | 1.4 | 146.3 | 15 | 330.4 |
| 15 | Caxanga | 508.9 | 31.3 | 10,337 | 11.2 | 69.2 | 44.6 | 500 | 3.2 | 0.5 | 128.7 | 9 | 106.4 |
| 16 | Igarassu 2 | 816.7 | - | 14,595 | - | 147.0 | 76.9 | 700 | 11.5 | 1.4 | 236.7 | 6 | 124.3 |
| 17 | Ipojuca - Sede | 105.4 | - | 4,473 | - | 19.0 | 9.9 | 700 | 1.0 | 0.3 | 30.1 | 6 | 50.4 |
| 18 | Itapissuma 1 | 101.7 | 20.8 | 2,522 | - | 14.6 | 7.3 | 300 | 0.5 | 0.5 | 22.9 | 12 | 43.4 |
| 19 | Itapissuma 2 | 99.2 | - | 2,460 | - | 17.9 | 9.3 | 300 | 0.6 | 0.5 | 28.3 | 9 | 40.9 |
| 20 | Comportas | 487.1 | - | 13,265 | 11.5 | 70.4 | 47.3 | 800 | 6.5 | 0.8 | 136.4 | 6 | 142.4 |
| 21 | Curcurana | 909.9 | 46.2 | 35,051 | 13.0 | 136.0 | 84.3 | 900 | 3.2 | 3.8 | 240.2 | 9 | 401.4 |
| 22 | Prazeres | 1,547.7 | 71.5 | 53,840 | 69.3 | 161.8 | 143.6 | 1,000 | 9.1 | 2.7 | 386.5 | 18 | 1,239.8 |
| 23 | Jaboatao 1 | 396.2 | 151.2 | 9,442 | 5.0 | 36.6 | 23.3 | 900 | 6.8 | 0.9 | 72.6 | 6 | 211.8 |
| 24 | Jaboatao 2 | 803.3 | - | 14,435 | - | 144.6 | 76.9 | 900 | 4.9 | 1.6 | 227.9 | 18 | 629.0 |
| 25 | Ibura de Cima | 321.9 | 153.3 | 10,010 | 8.8 | 17.1 | 15.8 | 500 | 2.3 | 1.1 | 45.1 | 12 | 154.5 |
| 26 | Jaboatao 3 | 528.2 | - | 9,492 | - | 95.1 | 50.9 | 700 | 2.1 | 1.7 | 149.8 | 6 | 172.7 |
| 27 | Bonanca | 114.2 | - | 1,473 | - | 20.6 | 10.3 | 200 | 2.5 | 0.3 | 33.6 | 6 | 14.7 |
| 28 | Moreno 1 | 208.8 | - | 4,566 | - | 37.6 | 18.4 | 500 | 2.8 | 1.5 | 60.3 | 12 | 105.5 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

## Table B.2-3 Development Works of Sewage Collection Facilities (2/2)

| No. | Sewerage Systems | Basic Planning Conditions | | | Sewers | | | | | | | Pump Stations | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Trunk and Pressure Sewers | | | | | |
| | | Sewerage Area in 2020 (ha) | Existing Sewerage Area (ha) | Hourly Maximum Sewage Flow in 2020 ($m^3$/day) | Condom. Collectors (km) | Conven-tional Collectors (km) | Branch Sewers (km) | Maximum Diameter of Pipes (mm) | Length of Trunk Sewers (km) | Length of Pressure Sewers (km) | Total Length (km) | Quantities of Pumps (set) | Motor Power (CV) |
| 30 | Moreno 3 | 38.5 | - | 842 | - | 6.9 | 3.9 | 200 | 1.2 | 0.4 | 12.3 | 3 | 12.1 |
| 31 | Camaragibe 3 | 621.8 | 150.9 | 8,555 | 2.6 | 80.8 | 46.0 | 600 | 2.2 | 1.7 | 133.4 | 12 | 177.5 |
| 32 | Sao Lourenco 1 | 921.7 | 298.9 | 14,115 | 0.1 | 112.0 | 59.0 | 900 | 6.2 | 4.1 | 181.3 | 9 | 114.2 |
| 33 | Sao Lourenco 2 | 652.7 | - | 10,309 | - | 117.5 | 61.3 | 500 | 4.5 | 1.1 | 184.4 | 6 | 34.5 |
| 34 | Boa Viagem | 1,281.3 | 152.1 | 45,402 | 17.6 | 176.9 | 103.8 | 1,000 | 13.1 | 3.7 | 315.1 | 33 | 612.7 |
| 35 | Imbiribeira | 550.4 | 168.2 | 16,251 | 8.2 | 56.5 | 31.5 | 700 | 8.1 | 3.5 | 107.8 | 27 | 307.8 |
| 36 | Jardim Sao Paulo | 497.6 | 104.6 | 13,511 | 13.7 | 50.2 | 37.9 | 1,000 | 7.1 | 5.2 | 114.1 | 36 | 2,016.4 |
| 37 | Ibura de Baixo | 1,400.4 | 93.9 | 38,075 | 55.1 | 152.6 | 121.5 | 800 | 2.4 | 1.4 | 332.9 | 9 | 115.2 |
| 38 | Ignes Andreazza | 47.4 | 37.9 | 1,620 | - | 1.7 | 0.9 | - | - | - | 2.7 | - | - |
| 39 | Mangueira | 285.8 | 112.8 | 10,641 | 9.0 | 17.7 | 17.3 | - | - | - | 44.0 | - | - |
| 40 | Roda de Fogo | 170.8 | 144.6 | 6,477 | 0.9 | 3.4 | 2.6 | - | - | - | 6.9 | - | - |
| 41 | Janga | 2,878.7 | 1,105.7 | 97,013 | - | 319.1 | 174.7 | 900 | 4.7 | 5.1 | 503.6 | 6 | 341.5 |
| 42 | Paulista | 783.3 | 345.2 | 16,997 | - | 78.9 | 42.0 | 800 | 1.8 | 2.5 | 125.2 | 15 | 324.2 |
| 43 | Conceicao | 709.6 | 50.0 | 19,888 | - | 118.7 | 63.3 | 800 | 2.7 | 4.0 | 188.7 | 9 | 304.7 |
| 44 | Apipucos | 129.7 | - | 3,281 | 1.6 | 21.0 | 13.0 | - | - | - | 35.5 | - | - |
| 45 | Curado | 102.5 | 102.5 | 3,399 | 3.2 | - | - | - | - | - | 3.2 | - | - |
| 46 | Praia Porto de Galinhas | 49.4 | - | 936 | - | 15.6 | 8.7 | - | - | - | 24.3 | - | - |
| 47 | Jardim Paulista | 282.4 | 282.4 | 6,066 | - | - | - | - | - | - | - | - | - |
| 48 | Mirueira | 401.5 | 401.5 | 8,386 | - | - | - | - | - | - | - | - | - |
| 49 | Mutirio | 72.5 | 65.3 | 2,132 | - | 1.3 | 0.7 | - | - | - | 2.0 | - | - |
| 50 | Nova Cruz | 92.0 | - | 1,577 | - | 16.6 | 9.2 | - | - | - | 25.8 | - | - |
| 51 | Parque Capibaribe | 460.3 | 425.2 | 7,270 | - | 6.3 | 3.5 | - | - | - | 9.8 | - | - |
| 52 | Parque Pirapama | 172.6 | 51.8 | 8,124 | - | 21.7 | 12.1 | - | - | - | 33.8 | - | - |
| 53 | Vila Burity | 68.0 | 20.5 | 2,220 | 4.1 | 2.4 | 4.8 | - | - | - | 11.3 | - | - |
| 54 | Vila dos Milagres | 99.4 | 99.4 | 2,994 | - | - | - | - | - | - | - | - | - |
| 55 | 27 de Novembro | 48.6 | 3.2 | 1,620 | 5.7 | - | 4.5 | - | - | - | 10.3 | - | - |
| Total of 55 Systems | | 29,959 | 8,516 | 852,970 | 530.2 | 3,076.5 | 2,063.0 | 24,600 | 133.0 | 65.0 | 5,867.7 | 441 | 9,748 |

# Table B.2-4 Installation Record of RAFA Reactors in Parana State (1/2)

| No. | Sewerage System | Treatment Plant | Type of Process |
|---|---|---|---|
| 1 | Iboiti | ETE Norte | RAFA + Biological Filtration |
| | | ETE S. Lourenco | RAFA + Lagoon |
| | | ETE Sul | RAFA + Biological Filtration |
| | | RALF Santos Dumont | RAFA |
| | | RALF Seltinhos | RAFA |
| 2 | Cambe | ETE Cacadores | RAFA + Biological Filtration |
| | | ETE Sao Domingos | RAFA + Storage |
| | | ETE Castelo | RAFA |
| 3 | Assis Chateaubraind | ETE Assis Chateaubrsiand | RAFA + Lagoon |
| 4 | Palotina | ETE Palotina | RAFA + Lagoon |
| 5 | Guaria | ETE Guaria | RAFA |
| 6 | Campo Murao | ETE Rio do Campo | RAFA + Lagoon |
| 7 | Balsa Nova | ETE Balsa Nova | RAFA |
| 8 | Cruz Machado | ETE Cruz Machado | RAFA |
| 9 | Vila dos Brasileiros | ETE Vila dos Brasileiros | RAFA |
| 10 | Araponga s | ETE Campinho | RAFA + Lagoon |
| | | ETE Bangeirante Norte | RAFA + Lagoon |
| 11 | Rolandia | ETE Cafezal | RAFA |
| | | ETE Ribeiro Vermelho | RAFA + Lagoon |
| 12 | Porecatu | ETE Capim | RAFA |
| 13 | Bela Vista do Paraiso | ETE Indiana | RAFA + Lagoon |
| 14 | Nova Esperanca | ETE Caxanga | RAFA + Lagoon |
| 15 | Parana City | ETE Parana City | RAFA |
| 16 | Astorga | ETE Jaboticabal | RAFA + Lagoon |
| | | ETE Taquari | RAFA + Lagoon |
| 17 | Mandaguagu | ETE Mandaguagu | RAFA + Lagoon |
| 18 | Mandaguari | ETE Keller I | RAFA |
| | | ETE Keller II | RAFA |
| | | ETE Keller III | RAFA |
| 19 | Guaraniacu | | RAFA + Lagoon |
| 20 | Pitanga | | RAFA + Lagoon |
| 21 | Laranjeiras do Sul | | RAFA |
| 22 | Pinhao | | RAFA |
| 23 | Quedas do Iguacu | | RAFA + Anaerobic Bio-filtration |
| 24 | Medianeira | | RAFA |
| 25 | Matelandia | | RAFA |
| 26 | Vera Cruz do Oeste | | RAFA + Lagoon |
| 27 | Vila dos Brasileiros | | RAFA |
| 28 | Alto Parana | | RAFA |
| 29 | Barbosa Ferraz | | RAFA + Lagoon |
| 30 | Candido de Abrue | ETE I | RAFA + Lagoon |
| | | ETE II | RAFA + Lagoon |
| 31 | Cianorte | ETE I | RAFA + Lagoon |
| | | ETE II | RAFA + Lagoon |
| 32 | Cidado Gaucha | | RAFA + Lagoon |
| 33 | Cruzeiro do Oeste | ETE I | RAFA + Lagoon |
| | | ETE II | RAFA + Sedimentation |
| 34 | Doutor Camargo | ETE I | RAFA + Lagoon |
| | | ETE II | RAFA + Lagoon |
| 35 | Ivaipora | | RAFA |
| 36 | Jandaia | ETE I | RAFA |
| | | ETE II | RAFA |
| 37 | Loanda | | RAFA + Lagoon |
| 38 | Rondon | | RAFA |
| 39 | Sao Joan do Caiua | | RAFA + Lagoon |
| 40 | Sao Pedro do Ivai | ETE I | RAFA + Lagoon |
| | | ETE II | RAFA + Lagoon |
| 41 | Terra Boa | | RAFA |
| 42 | Paranavai | ETE Vila Operaria | RAFA + Lagoon |
| | | ETE Vila City | RAFA + Lagoon |
| 43 | Campo Largo | ETE Cambui | RAFA + Flotation |
| 44 | Carro Azul | | RAFA |
| 45 | Mandirituba | | RAFA |
| 46 | Morretes | | RAFA |
| 47 | Metinhos | | RAFA + Lagoon |
| 48 | Lapa | | RAFA |
| 49 | Quatro Barras | | RAFA + Lagoon |
| 50 | Rio Azul | | RAFA |
| 51 | Rio Negro | | RAFA + Sedimentation |
| 52 | Sao Joan do Triufo | | RAFA |
| 53 | Sao Mateus do Sul | | RAFA |
| 54 | Uniao da Vitoria | ETE Sao Bernardo | RAFA |
| | | ETE Joao Paulo II | RAFA |
| | | ETE Cristo Rei | RAFA |
| 55 | Foz do Iguacu | ETE 01 | RAFA |
| | | ETE 02 | RAFA |
| | | ETE 03 | RAFA |
| | | ETE 09 | RAFA |
| | | ETE Europa | RAFA + Anaerobic Filtration |
| | | ETE Apore | RAFA |
| | | ETE 06 | RAFA |
| 56 | Renascenca | | RAFA |
| 57 | Pranchita | | RAFA |
| 58 | Toledo | ETE I-7 | RAFA |
| | | ETE I-6 | RAFA |
| | | ETE II-7 | RAFA |
| | | ETE III-4 | RAFA |
| | | ETE III | RAFA |
| | | ETE I-4 | RAFA |
| | | ETE Jardim Paulista | RAFA |
| 59 | Pinhais | ETE Vila Tebas | RAFA + Lagoon |
| 60 | Sao Jose dos Pinhais | ETE Afonso Pena | RAFA |
| | | ETE Gralha Azul | RAFA |
| 61 | Araucaria | ETE Cachoeira | RAFA |
| | | ETE Costeria I | RAFA |
| | | ETE Costeira II | RAFA |
| 62 | Colombo | ETE Guaraituba | RAFA |
| 63 | Araucaria | | RAFA |
| 64 | Bocaiuva do Sul | | RAFA |
| 65 | Ipiranga | | RAFA |
| 66 | Irati I | | RAFA |
| 67 | Irati II | | RAFA |
| 68 | Ivai | | RAFA + Lagoon |
| 69 | Lapa | | RAFA |
| 70 | Mallet | | RAFA + Filtration |
| 71 | Ortigueira | | RAFA |
| 72 | Ponta Grossa | | RAFA + Lagoon |
| 73 | Prudentopolis | | RAFA |
| 74 | Telemaco Borda | ETE II-6 Mutirao | RAFA |
| | | ETE I Bandeirantes | RAFA |
| 75 | Tibagi | | RAFA |
| 76 | Vila dos Brasileiros | | RAFA |
| 77 | Ponta Grossa | ETE Verde | RAFA + Lagoon |
| | | ETE Ronda | RAFA + Lagoon |
| | | ETE Cristo Rei | RAFA |
| | | ETE Rubine | RAFA |
| | | ETE Verona | RAFA |
| | | ETE Conceicao | RAFA |
| | | ETE Olarias | RAFA + Lagoon |
| 78 | Apucarana | ETE Jaboti | RAFA |
| | | ETE Biguacu | RAFA |
| 79 | Rosario do Ivai | | RAFA |
| 80 | Andira | ETE Antas | RAFA |
| | | ETE Barbeiro | RAFA |
| 81 | Cambara | ETE Alambary | RAFA |
| | | ETE Elevat. Vila Sao Jose | RAFA |
| 82 | Cartopolis | ETE Xavantes | RAFA |
| 83 | Conselheiro Mairinck | ETE Rio Vermelho | RAFA + Filtration |
| 84 | Cornelio Procopio | ETE Tangara | RAFA |
| | | ETE Ribeirao Veado | RAFA |
| | | ETE Sao Luiz | RAFA |
| | | Elevat. Jardim Panorama | RAFA |

# Table B.2-4 Installation Record of RAFA Reactors in Parana State (2/2)

| No. | Sewerage System | Treatment Plant | Type of Process |
|---|---|---|---|
| 85 | Jacarezinho | ETE Ourinhos | RAFA |
| 86 | Joaquim Tabora | ETE Ourinhos | RAFA |
| 87 | Pinhalao | ETE Pinhalao | RAFA |
| 88 | Salto Itarare | ETE Itarare | RAFA + Lagoon |
| 89 | Santa Mariana | ETE Araras | RAFA + Lagoon |
| 90 | Santa Antonio Platina | ETE Boi Pintado | RAFA + Lagoon |
| 91 | Siquira Campos | ETE Fartura | RAFA |
| 92 | Urai | ETE Congonhas | RAFA + Sedimentation |
| 93 | Wenceslau Braz | Noste-Olho A'agua | RAFA |
| | | Sul-Matadouro | RAFA |
| 94 | Curitiba | ETE Aete | RAFA |
| | | ETE Ana Celria | RAFA |
| | | ETE Araucaria I | RAFA |
| | | ETE Araucaria II | RAFA |
| | | ETE Atuba Sul | RAFA |
| | | ETE Augusta | RAFA |
| | | ETE Azeieia | RAFA |
| | | ETE Barbacena | RAFA |
| | | ETE Blame | RAFA |
| | | ETE Bel Terra | RAFA |
| | | ETE Bracatinga | RAFA |
| | | ETE Caicaras | RAFA |
| | | ETE Calcua | RAFA |
| | | ETE Califomia | RAFA |
| | | ETE Campo Comprido | |
| | | ETE Campos Elisaos | |
| | | ETE Capiberibe | |
| | | ETE Cibtia Liz | |
| | | ETE Cotolengo I | |
| | | ETE Cotolengo II | |
| | | ETE Curitiba | |
| | | ETE Damasco | |
| | | ETE Flamboyant | |
| | | ETE Garcas | |
| | | ETE Girassol | |
| | | ETE Goncalves Dias | |
| | | ETE Granha Azul | |
| | | ETE Greenville | |
| | | ETE Iguape | |
| | | ETE Ilha do Sol | |
| | | ETE Ilha Verde | |
| | | ETE Itacolomi | |
| | | ETE Itatiaia | |
| | | ETE Jerusalem | |
| | | ETE Juliana Liz | |
| | | ETE Lisboa | |
| | | ETE Mal. Cadido Rondon | |
| | | ETE Marumbi | |
| | | ETE Monte Verde | |
| | | ETE Moradias da Cunha | |
| | | ETE Nossa Sra. Da Luz | |
| | | ETE Nova Orians | |
| | | ETE Osavaldo Cruz V | |
| | | ETE Ouro Verde | |
| | | ETE Padilha | |
| | | ETE Parque Verde | |
| | | ETE Pinus | |
| | | ETE Pirineus | |
| | | ETE Porto Seguro I | |
| | | ETE Porto Seguro II | |
| | | ETE Santa Candida | |
| | | ETE Santa Quiteria | |
| | | ETE Santo Andre | |
| | | ETE Sao Joao Del Rey II | |
| | | ETE Saquerema | |
| | | ETE Siriema | |
| | | ETE Tambau | |
| | | ETE Tanque dos Muller | |
| | | ETE Tramontina | |
| | | ETE Vila Rica | |
| | | ETE Vilas Novas | |
| | | ETE Zimbros | |

| No. | Sewerage System | Treatment Plant | Type of Process |
|---|---|---|---|

Source: Provided by SANEPAR in the State of Parana (Jan. 6 in 2000).
Note: The data shows the installation numbers as of the end of 1999), which are totaled into 94 of sewerage systems and 206 of sewage treatment stations.

## Table B.2-5 Comparison of Biological Treatment Processes (1/2)

| Processes | Items | Characteristics | Applied Criteria |
|---|---|---|---|
| 1. Activated Sludge Process | | | |
| | Major components | • Aeration tank<br>• Sedimentation tank<br>• Aeration unit<br>• Sludge return pump | |
| | BOD removal | 92 % (88 to 95 %) | |
| | Construction cost | 500 R$/$m^3$/d | • BOD loading rate: 0.6 kg/$m^3$/d<br>• Depth of aeration tank: 4.0m<br>• Surface loading rate: 24 $m^3/m^2$/d |
| | Required Space | 0.17 $m^2/m^3$/d | |
| | Required energy | 0.35 kw/$m^3$ | • Required oxygen: 1.4 kg-$O_2$/kg-BOD<br>• Aeration efficiency: 0.80 kwh/kg-$O_2$ |
| | Surplus sludge | 0.33 kg-DS/$m^3$ | • Generation rate: 1.0 kg-DS/kg-SS |
| | Control points | • Control of MLSS concentration<br>• Control of DO level in aeration tanks | |
| | Possible problems | • Bulking<br>• Generation of scum in sedimentation tanks<br>• Foaming in aeration tanks | |
| 2. Oxidation Ditch Process | | | |
| | Major components | • Oxidation ditch<br>• Sedimentation tank<br>• Aeration rotor<br>• Sludge return pump | |
| | BOD removal | 90 % (85 to 95 %) | |
| | Construction cost | 530 R$/$m^3$/d | • BOD loading rate: 0.2 kg/$m^3$/d<br>• Depth of ditch: 3.0m<br>• Surface loading rate: 24 $m^3/m^2$/d |
| | Required Space | 0.54 $m^2/m^3$/d | |
| | Required energy | 0.39 kw/$m^3$ | • Required oxygen: 1.6 kg-$O_2$/kg-BOD<br>• Aeration efficiency: 0.80 kwh/kg-$O_2$ |
| | Surplus sludge | 0.25 kg-DS/$m^3$ | • Generation rate: 0.75 kg-DS/kg-SS |
| | Control points | • Control of MLSS concentration<br>• Control of DO level in aeration tanks | |
| | Possible problems | • Bulking<br>• Generation of scum in sedimentation tanks | |
| 3. Aerated Lagoon Process | | | |
| | Major components | • Aerated lagoon<br>• Aerator | |
| | BOD removal | 80 % (70 to 85 %) | |
| | Construction cost | 260 R$/$m^3$/d | • BOD loading rate: 0.04 kg/$m^3$/d<br>• Depth of lagoon: 4.0m |
| | Required Space | 0.19 $m^2/m^3$/d | |
| | Required energy | 0.47 kw/$m^3$ | • Aeration intensity: 1.6 kw/kg-BOD |
| | Surplus sludge | 0.17 kg-DS/$m^3$ | • Generation rate: 0.5 kg-DS/kg-SS |
| | Control points | • Nothing particular | |
| | Possible problems | • Low transparency of treated water | |

## Table B.2-5 Comparison between Biological Treatment Processes (2/2)

| | | | |
|---|---|---|---|
| 4. Bio-Filter Process | | | |
| | Major components | • Bio-Filter<br>• Sedimentation tank<br>• Circulation pump | |
| | BOD removal | 75 % (70 to 80 %) | |
| | Construction cost | 460 R$/m$^3$/d | • BOD loading rate: 1.0 kg/m$^3$/d |
| | Required Space | 0.23 m$^2$/m$^3$/d | • Depth of filter media: 2.0m |
| | Required energy | 0.07 kw/m$^3$ | |
| | Surplus sludge | 0.17 kg-DS/m$^3$ | • Generation rate: 0.5 kg-DS/kg-SS |
| | Control points | • Circulated flow of treated water | |
| | Possible problems | • Low transparency of treated water<br>• Generation of flies and offensive odor | |
| 5. RAFA + Lagoon Process | | | |
| | Major components | • RAFA<br>• Lagoon (Stabilization pond) | |
| | BOD removal | 90 % (80 to 90 %) | |
| | Construction cost | 210 R$/m$^3$/d | • BOD loading rate of RAFA: 1.5 kg/m$^3$/d |
| | Required Space | 2.0 m$^2$/m$^3$/d | • Retention time of lagoon: 3 days |
| | Required energy | Neglected | |
| | Surplus sludge | 0.12 kg-DS/m$^3$ | • Generation rate in RAFA: 0.35 kg-DS/kg-SS |
| | Control points | • Sludge volume in RAFA | |
| | Possible problems | • Wash-out of granular sludge<br>• Generation of offensive odor | |
| 6. RAFA + Bio-Filtration Process | | | |
| | Major components | • RAFA<br>• Bio-Filter<br>• Sedimentation Tank<br>• Circulation pump | |
| | BOD removal | 90 % (85 to 92 %) | |
| | Construction cost | 370 R$/m$^3$/d | • BOD loading rate of RAFA: 1.5 kg/m$^3$/d |
| | Required Space | 0.13 m$^2$/m$^3$/d | • BOD loading rate of Bio-filter: 1.0 kg/m$^3$/d |
| | Required energy | 0.07 kw/m$^3$ | |
| | Surplus sludge | 0.12 kg-DS/m$^3$ | • Generation rate in RAFA: 0.35 kg-DS/kg-SS |
| | Control points | • Sludge volume in RAFA | |
| | Possible problems | • Wash-out of granular sludge<br>• Generation of offensive odor | |

Note: The cost of land acquisition is exclusive from construction costs.
Source: JICA Study Team.

## Table B.2-6 Modification Methods of Existing Treatment Facilities

| No. | Sewerage System | Item No. of Existing Facilities | Daily Average Sewage Flow ($m^3$/day) | | | Existing Treatment Process | Expansion Methods |
|---|---|---|---|---|---|---|---|
| | | | In 2020 | Existing | Capacity to be Expanded | | |
| 1 | Caetes | ETEJ-03 | 11,014 | 8,900 | 2,114 | AL | RAFA(new) + LG(AL to be converted) |
| 2 | Peixinhos | ETEX-01 | 57,196 | 36,000 | 21,196 | PS + BF + SS | RAFA(new) + BF(new and existing) + SS(new and existing) |
| 3 | Cabanga | ETEC-01 | 55,146 | 80,000 | - | PS | RAFA(new) + BF(new) + SS(PS to be converted) |
| 4 | Moreno 2 | ETES-13 | 1,017 | 854 | 163 | SP | RAFA(new) + LG(existing) |
| 5 | Ignes Andreazza | ETES-01 | 988 | 2,217 | - | EA | Only rehabilitation of existing facilities |
| 6 | Mangueira | ETEC-10 | 5,815 | 3,732 | 2,083 | RAFA + LG | RAFA(new) + LG(new), using existing RAFA + LG |
| 7 | Roda de Fogo | ETEC-07 | 3,892 | 4,752 | - | ST + AF | RAFA(new) + LG(new) |
| 8 | Janga | ETEJ-01 | 59,885 | 34,214 | 25,671 | OD | RAFA(new) + LG(new), using existing Oxidation Ditch |
| 9 | Curado | ETES-02 | 2,031 | 7,021 | - | AL | RAFA(new) + LG(AL to be converted) |
| 10 | Jardim Paulista | ETEJ-04 | 3,954 | 3,085 | 869 | AL | RAFA(new) + LG(AL to be converted) |
| 11 | Mutirao | ETEJ-06 | 1,334 | 1,700 | - | SP | RAFA(new) + LG(existing) |
| 12 | Parque Capibaribe | ETES-04 | 4,923 | 2,735 | 2,188 | AL | RAFA(new) + LG(AL to be converted) |
| 13 | Parque Pirapama | ETES-03 | 6,700 | 3,060 | 3,640 | AL | RAFA(new) + LG(AL to be converted) |
| 14 | Vila Burity | ETEX-02, 03, 04, 05 | 1,350 | 1,250 | 1,350 | ST + AF | RAFA(new) + LG(new) |
| 15 | Vila dos Milagres | ETES-16 | 1,853 | 1,853 | - | RAFA + LG | Only rehabilitation of existing facilities |
| 16 | 27 de Novembro | ETES-05 | 963 | 963 | - | SP | RAFA(new) + LG(existing) |
| 17 | Paulista | ETEJ-02 | 11,052 | 6,750 | 4,302 | AL | RAFA(new) + LG(existing) |
| 18 | Prazeres | ETEC-02 | 32,581 | 1,625 | 30,956 | AL | RAFA(new) + LG(existing), to be used as another facilities after improved to (RAFA + LG), separately from the main Subsystem. |
| 19 | Curcurana | ETEC-03<br>ETEC-09 | 21,280 | 1,833<br>3,142 | 16,305 | OD<br>RAFA + LG | To be used as another facilities after rehabilitated, separately from the main Subsystem. |
| 20 | Cordeiro | ETEC-08 | 16,319 | 4,416 | 11,903 | RAFA | RAFA(existing) + LG(new), to be used as another facilities after improved, separately from the main Subsystem. |
| Total | | | 220,081 | 210,102 | | | |

Note: The abbreviations in table represent the following:
AL: Aerated Lagoon, PS: Primary Sedimentation, BF: Bio-Filter, SS: Secondary Sedimentation, SP: Stabilization Pond, EA: Extended Aeration, RAFA: RAFA Reactor, ST: Septic Tank, OD: Oxidation Ditch, AF: Anaerobic Filter, LG: Lagoon

## Table B.2-7 Development Works of STFs (1/2)

| No. | Sewerage System | Basic Planning Conditions | | | Applied Unit Process of Sewage Treatment | | | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Daily Ave. Sewage Flow in 2020 ($m^3$/day) | Existing Capacity (Daily Ave. Flow) ($m^3$/day) | Capacity to be Expanded (Daily Ave. Flow) ($m^3$/day) | Influent Pump | Grit Chamber | Primary Sedimentation Tank | RAFA Reactor | Lagoon | Bio-Filter and Final Sedimentation Tank | Aeration Tank and Final Sedimentation Tank | Chlorination Unit | Sludge Thickener | Sludge Digester | Dehydrator | Sludge Drying Bed | |
| 1 | Caetes | 11,014 | 8,900 | 2,114 | | ● | | ● | □ | | | ● | | | | ● | |
| 2 | Peixinhos | 57,279 | 36,000 | 21,279 | | ● | | ● | | ● | | ● | ● | □ | ● | | |
| 3 | Caixa D'agua | 5,134 | - | 5,134 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 4 | Nova Descoberta | 7,138 | - | 7,138 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 5 | Aguazinha | 6,569 | - | 6,569 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 6 | Dois Unidos | 8,243 | - | 8,243 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 7 | Ponte dos Carvalhos | 3,615 | - | 3,615 | | ● | | ● | ● | | | ● | | | | ● | |
| 8 | Charnequinha | 2,174 | - | 2,174 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 9 | Camaragibe/Recife 1 | 11,254 | - | 11,254 | | ● | | ● | ● | | | ● | | | | ● | |
| 10 | Camaragibe/Recife 2 | 3,220 | - | 3,220 | | ● | | ● | ● | | | ● | | | | ● | |
| 11 | Camaragibe 1 | 4,450 | - | 4,450 | | ● | | ● | ● | | | ● | | | | ● | |
| 12 | Camaragibe 2 | 3,380 | - | 3,380 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 13 | Cabanga | 55,239 | 80,000 | 55,239 | □ | | □ | ● | | ◎ | | ● | ● | □ | ● | | |
| 14 | Cordeiro | 16,319 | 4,416 | 11,903 | ● | ● | | ● | | ● | | ● | | | | ● | The existing ETEC-08 will be used as an another station. |
| 15 | Caxanga | 6,690 | - | 6,690 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 16 | Igarassu 2 | 9,690 | - | 9,690 | | ● | | ● | ● | | | ● | | | | ● | |
| 17 | Ipojuca - Sede | 2,687 | - | 2,687 | | ● | | ● | ● | | | ● | | | | ● | |
| 18 | Itapissuma 1 | 1,614 | - | 1,614 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 19 | Itapissuma 2 | 1,574 | - | 1,574 | | ● | | ● | ● | | | ● | | | | ● | |
| 20 | Comportas | 8,275 | - | 8,275 | | ● | | ● | ● | | | ● | | | | ● | |
| 21 | Curcurana | 21,280 | 404 | 20,876 | ● | ● | | ● | | ● | | ● | | | | ● | The existing ETEC-11will be used an another station. |
| 22 | Prazeres | 32,581 | 1,625 | 30,956 | ● | ● | | ● | | ● | | ● | | | | ● | The existing ETEC-02 will be used an another station. |
| 23 | Jaboatao 1 | 5,956 | - | 5,956 | | ● | | ● | ● | | | ● | | | | ● | |
| 24 | Jaboatao 2 | 9,656 | - | 9,656 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 25 | Ibura de Cima | 6,097 | - | 6,097 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 26 | Jaboatao 3 | 6,349 | - | 6,349 | | ● | | ● | ● | | | ● | | | | ● | |
| 27 | Bonanca | 1,046 | - | 1,046 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 28 | Moreno 1 | 2,969 | - | 2,969 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 29 | Moreno 2 | 1,017 | 854 | 163 | ● | ● | | ● | □ | | | ● | | | | □ | |

## Table B.2-7 Development Works of STFs (2/2)

| No. | Sewerage System | Basic Planning Conditions | | | Applied Unit Process of Sewage Treatment | | | | | | | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Daily Ave. Sewage Flow in 2020 ($m^3$/day) | Existing Capacity (Daily Ave. Flow) ($m^3$/day) | Capacity to be Expanded (Daily Ave. Flow) ($m^3$/day) | Influent Pump | Grit Chamber | Primary Sedimentation Tank | RAFA Reactor | Lagoon | Bio-Filter and Final Sedimentation Tank | Aeration Tank and Final Sedimentation Tank | Chlorination Unit | Sludge Thickener | Sludge Digester | Dehydrator | Sludge Drying Bed | |
| 30 | Moreno 3 | 547 | - | 547 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 31 | Camaragibe 3 | 5,967 | - | 5,967 | | ● | | ● | ● | | | ● | | | | ● | |
| 32 | Sao Lourenco 1 | 9,619 | - | 9,619 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 33 | Sao Lourenco 2 | 6,981 | - | 6,981 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 34 | Boa Viagem | 27,794 | - | 27,794 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 35 | Imbiribeira | 10,103 | - | 10,103 | | ● | | ● | ● | | | ● | | | | ● | |
| 36 | Jardim Sao Paulo | 8,384 | - | 8,384 | | ● | | ● | ● | | | ● | | | | ● | |
| 37 | Ibura de Baixo | 23,557 | - | 23,557 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 38 | Ignes Andreazza | 988 | 2,217 | - | □ | □ | | | | | □ | ● | | | | □ | |
| 39 | Mangueira | 6,430 | 3,732 | 2,698 | | ● | | ● | ● | | | ● | | | | ● | |
| 40 | Roda de Fogo | 3,892 | 4,752 | 3,892 | ● | ● | | ● | ● | | | ● | | | | ● | |
| 41 | Janga | 59,891 | 34,214 | 25,677 | | ● | | ● | ● | | | ● | | | | ● | |
| 42 | Paulista | 11,052 | 6,750 | 4,302 | | ● | | ● | □ | | | ● | | | | ● | |
| 43 | Conceicao | 12,515 | - | 12,515 | | ● | | ● | ● | | | ● | | | | ● | |
| 44 | Apipucos | 2,076 | - | 2,076 | ● | ● | | ● | □ | ● | | ● | | | | ● | |
| 45 | Curado | 2,031 | 7,021 | 2,031 | □ | □ | | ● | ● | | | ● | | | | ● | |
| 46 | Praia Porto de Galinha | 621 | - | 621 | | ● | | ● | ● | | | ● | | | | ● | |
| 47 | Jardim Paulista | 3,954 | 3,085 | 3,954 | | ● | | ● | □ | | | ● | | | | ● | |
| 48 | Mirueira | 5,478 | - | 5,478 | ● | ● | | ● | | ● | | ● | | | | ● | |
| 49 | Mutirao | 1,334 | 1,700 | 1,334 | □ | □ | | ● | □ | | | ● | | | | ● | |
| 50 | Nova Cruz | 1,053 | - | 1,053 | | ● | | ● | ● | | | ● | | | | ● | |
| 51 | Parque Capibaribe | 4,923 | 2,735 | 2,188 | ● | ● | | ● | □ | | | ● | | | | ● | |
| 52 | Parque Pirapama | 4,845 | 3,060 | 1,785 | ● | ● | | ● | □ | | | ● | | | | ● | |
| 53 | Vila Burity | 1,350 | 1,250 | 1,350 | ● | ● | | ● | ● | | | ● | | | | ● | |
| 54 | Vila dos Milagres | 1,853 | 1,853 | 1,853 | □ | □ | | □ | □ | | | □ | | | | □ | |
| 55 | 27 de Novembro | 963 | 963 | 963 | □ | □ | | ● | □ | | | ● | | | | ● | |
| Total | | 530,710 | 204,146 | 428,658 | | | | | | | | | | | | | |

Note: 1) The unit processes marked by "●" are newly installed and the ones marked by "□" represents existing components.

2) The existing primary sedimentation tank marked by "◎" are used as the final sedimentation ones.

## Table B.2-8 Rehabilitation Works of Existing Sewerage Systems (1/2)

| No. | Sewerage System | Pump Stations to be Rehabilitated | Sewage Treatment Facilities |
|---|---|---|---|
| 1 | Caetes | EEJ-4(Caetes-3), EEJ-22(Caetes-I) | ETEJ-03(Caetes): Repair and replacement of mechanical parts of screen, flow meter, aerators, etc., and dredging of lagoons. |
| 2 | Peixinhos | EEJ-14(Varadouro), EEX-1(Arruda), EEX-2(Encruzilhada), EEX-3(Rui Barbosa), EEX-11(Convention Center), EEX-12(Joao Paulo-II), EEX-13(Varadouro-II), EEX-14(COHAB), | ETEX-01(Peixinhos): Repair and replacement of mechanical parts of screen, grit chambers, primary sedimentation tanks, bio-filter, final sedimentation tanks, pumps and digesters, repair of civil and architectural structures, and replacement of filter-media. |
| 3 | Aguazinha | EEX-20(Passarinho), EEX-21(Varadouro-I), EEX-22(Canaa) | None |
| 4 | Cabanga | EEX-4(Aurora), EEX-5(J. Brasil), EEX-7(Ponte Velha), EEX-10)Henrique Dias), EEC-1(Afogados), EEC-2(Internacional), EEC-8(D-3), EEC-9(Jiquia), EEC-15(Abdias de Carvalho), EEC-17(Prive da | ETEC-01(Cabanga): Repair and replacement of mechanical parts for influent pumps, screens, grit chambers, primary sedimentation tanks, digesters, etc. and repair of civil and architectural structures. |
| 5 | Cordeiro | None | ETEC-8(Vila Iputinga) to be used as another system, separately from the main Subsystem: Repair and replacement of machinery parts for influent pumps, etc. and civil and architectural structures. |
| 6 | Curcurana | EEC-10(Barra de Jangada), EEC-21(Costa do Sol) | ETEC-03(Barra de Jangada) and ETEC-09(Praia Grande) to be used as another facility, separately from the main Subsystem: Repair and replacement of machinery parts of influent pumps, etc., civil and architectural structures. |
| 7 | Prazeres | EEC-16(Jardim Piedade), EEC-29(Praia Grande) | ETEC-02(Jardam Piedade) to be used as another facility, separately from the main Subsystem: Repair and replacement of machinery parts of influent pumps, aerators, etc., civil and architectural structures and dredging of a lagoon. |
| 8 | Moreno 2 | None | ETES-13(Vila Liberdade): Repair of mechanical parts, internal pipings and desludging of a septic tank. |
| 9 | Boa Viagem | EEC-6(D-18), EEC-13(D-20), EEC-19(Boa Viagem) | None |
| 10 | Imbiribeira | EEC-20(Imbiribeira) | None |
| 11 | Ignes Andreaza | None | ETES-01(Ignes Andreaza): Repair and replacement of mechanical parts of influent pumps, screens, grit chambers, a sedimentation tank, aeration tanks, aerators, etc. and repair of civil and architectural structures. |
| 12 | Mangueira | None | ETEC-10(Mangeira): Repair and replacement of mechanical parts for influent pumps, screens, grit chambers, etc., repair of civil structures and dredging of a lagoon. |
| 13 | Roda de Fogo | EEC-24(Roda de Fogo-01), EEC-25(Roda de Fogo-02), EEC-26(Roda de Fogo-03), EEC-27(Roda de Fogo-04) | ETES-07(Vila Roda de Fogo): Repair of mechanical parts, internal piping and desludging of a septic tank. |

## Table B.2-8 Rehabilitation Works of Existing Sewerage Systems (2/2)

| No. | Sewerage System | Pump Stations to be Rehabilitated | Sewage Treatment Facilities |
|---|---|---|---|
| 14 | Janga | EEJ-2(Maranguape-II), EEJ-3(pedras Altas), EEJ-5(Managuape-II), EEJ-8(Bairro Nova), EEJ-X(Dona Duda), EEJ-18(Inoccop Janga) | ETEJ-01(Janga): Repair and replacement of mechanical parts of screens, grit chambers, a sedimentation tank, aeration tanks, aerators, etc. and repair of civil and architectural structures. |
| 15 | Paulista | EEJ-19(Arthur Lundgren) | ETEJ-02(Arthur Lungren): Repair and replacement of mechanical parts of screen, flow meter, aerators, etc., and dredging of lagoons. |
| 16 | Conceicao | EEJ-17 | None |
| 17 | Curado | EES-1(Curado-IV), EES-4(Curado-II), | ETES-2(Curado-IV): Repair and replacement of mechanical parts of screen, flow meter, aerators, etc., and dredging of lagoons. |
| 18 | Jardim Paulista | EEJ-7(Paulista) | ETEJ-04(Jardim Paulista): Repair and replacement of mechanical parts for screen, flow meter, aerators, etc., and dredging of lagoons. |
| 19 | Mutirao | EEJ-11(Engenho Maranguape), EEJ-21(EE-2) | ETEJ-06(Mutirao): Repair of mechanical parts, internal pipings and desludging of a septic tank. |
| 20 | Parque Capibaribe | EES-13(Parque Capi-II), EES-14(Parque Capi-III) | ETES-04(Capibaribe Park): Repair and replacement of mechanical parts of screen, flow meter, aerators, etc., and dredging of lagoons. |
| 21 | Parque Pirapama | None | ETES-03(Pirapama Housing): Repair and replacement of mechanical parts for screen, flow meter, aerators, etc., and dredging of lagoons. |
| 22 | Vila Burity | EEX-16(vila Burity-I), EEX-17(vila Burity-X), EEX-18(vila Burity-III) | ETEX-02 to 05(Burity Village): Repair of mechanical parts, internal pipings and desludging of a septic tank. |
| 23 | Vila dos Milagres | EEX-16(Cabo-III), EES-21(vila dos Milagres), EES-22(vila dos Milagres) | ETEC-10(Mangeira): Repair and replacement of mechanical parts of influent pumps, screens, grit chambers, , etc. and repair of civil and dredging of a lagoon. |
| 24 | 27 de Novembro | None | ETES-05(UR-II-Ibura): Repair of mechanical parts, internal pipings and desludging of a pond. |

Source: Compiled by JICA Study Team based on the results of site investigation, reviewing the data prepared by

## Table B.4-1 Operation Data of Mangeira Treatment Plant

| Parameters | Units | Influx to RAFA | | | Outflow from RAFA (Inflow to Lagoon) | | | Outflow from Lagoon | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min. | Average | Max. | Min. | Average | Max. | Min. | Average | Max. |
| Temperature | °C | 26 | 31 | 36 | 27 | 30 | 34 | 27 | 31 | 35 |
| pH | - | 7.0 | 7.0 | 8.0 | 7.0 | 7.0 | 8.0 | 7.0 | 8.0 | 10.0 |
| Conductivity | $\mu$ S/cm | 819 | 1,553 | 2,790 | 718 | 1,429 | 2,520 | 782 | 1,322 | 2,070 |
| Salts | % | 0.1 | 1.0 | 1.0 | 0.1 | 1.0 | 1.0 | 0.1 | 1.0 | 1.0 |
| Total COD | mg/l | 78 | 380 | 1,638 | 46 | 153 | 405 | 74 | 167 | 540 |
| Filtered COD | mg/l | 47 | 225 | 523 | 13 | 97 | 310 | 22 | 91 | 498 |
| Total BOD | mg/l | 48 | 152 | 549 | 11 | 33 | 412 | 7 | 47 | 278 |
| Filtered BOD | mg/l | 49 | 109 | 259 | 13 | 26 | 238 | 7 | 38 | 110 |
| Alkalinity | mg-$CaCO_3$/l | 238 | 464 | 860 | 250 | 430 | 945 | 206 | 382 | 660 |
| Chlorates | mg-Cl/l | 55 | 201 | 335 | 80 | 194 | 316 | 20 | 187 | 288 |
| Total Solids | mg/l | 429 | 1,230 | 2,102 | 431 | 977 | 1,654 | 268 | 956 | 1,535 |
| Filtered Total Solids | mg/l | 44 | 831 | 1,336 | 66 | 729 | 1,339 | 53 | 683 | 1,088 |
| Soluble Volatile Total Solids | mg/l | 72 | 389 | 1,032 | 32 | 250 | 549 | 168 | 256 | 799 |
| Soluble Total Solids | mg/l | 20 | 203 | 1,028 | 16 | 78 | 220 | 36 | 97 | 336 |
| Soluble Filtered Solids | mg/l | 4 | 98 | 632 | 2 | 37 | 160 | 2 | 33 | 144 |
| Soluble Volatile Solids | mg/l | 12 | 109 | 508 | 6 | 40 | 108 | 2 | 65 | 192 |
| Total Kejudale Nitrogen | mg/l | 49 | 66 | 84 | 32 | 56 | 88 | 21 | 37 | 57 |
| Ammoniac Nitrogen | mg/l | 21 | 63 | 78 | 22 | 52 | 97 | 21 | 35 | 52 |
| Nitrate Nitrogen | mg/l | 0.03 | 0.04 | 0.06 | 0.03 | 0.04 | 0.06 | 0.16 | 0.17 | 0.18 |
| Nitrite Nitrogen | mg/l | 0.02 | 0.02 | 0.04 | - | 0.01 | 0.01 | 0.14 | 0.80 | 0.12 |
| Sulphate | mg/l | 15 | 48 | 79 | 8 | 32 | 50 | 6 | 43 | 67 |
| Phosphorus | mg/l | 3.0 | 5.0 | 9.0 | 4.0 | 5.0 | 6.0 | 2.0 | 4.0 | 5.0 |
| Total Coliforms* | MPN/100ml | 9.0E+05 | 1.0E+09 | 6.4E+14 | 3.0E+04 | 1.9E+07 | 1.5E+11 | 4.9E+03 | 3.0E+05 | 3.0E+09 |
| Fecal Coliforms* | MPN/100ml | 7.0E+05 | 1.5E+08 | 3.1E+14 | 3.0E+04 | 1.5E+06 | 2.3E+09 | 1.1E+03 | 3.0E+04 | 1.0E+08 |

Source: Presented at the Technology Transfer Seminar by Mario Takayuki Kato of Environmental Engineering, the Fedral University of Pernanbuco, on 23rd. May.

Remark: The data were collected during the period between December 1997 and March 2000.

## Table B.4-2 Evaluation of Combined Anaerobic Treatment Processes

| Items | RAFA + Bio-Filtration | RAFA + Lagoon | |
|---|---|---|---|
| | | RAFA + Facultative Lagoon | RAFA + Aerated Lagoon + Polishing Pond |
| 1. Characteristics of Processes | | | |
| • Process configurations | ➢ Sewage is treated by bio-filtration, which is accompanied by sedimentation after the pre-treatment of RAFA. | ➢ Sewage is treated by facultative lagoons with about 3-day HRT, after the pre-treatment of RAFA. | ➢ Sewage is treated by aerated lagoons with about 1-day HRT, after the pre-treatment of RAFA, and finally clarified by polishing ponds with 1.5- day HRT. |
| • BOD removal | ➢ The BOD removal rate is 75 % at RAFA and 60 % at bio-filtration, resulting in overall 90 % | ➢ Overall removal rate of 90 % is not possible in the facultative lagoon with 3-day HRT. To achieve 90 % removal rate, extremely long HRT is needed.<br>➢ In the Mangueira ETE, which employs this process, significant removal in a facultative lagoon cannot be found. | ➢ Following RAFA with the removal rate of 75 %, overall rate 90 % can be achieved by the combination of aerated lagoons and polishing ponds with 60 % removal rate. |
| • Experience in application | ➢ The State of Parana has the experience in the installation of "RAFA + Bio-Filtration."<br>➢ Bio-Filtration process has countless experience in diverse kinds of wastewater treatment. | ➢ There are two actual ETEs in the RMR and many in the State of Parana. However, these are not aimed at 90 % BOD removal and facultative ponds are mainly for the disinfection of treated sewage. | ➢ Certain numbers of actual plants are under construction in Brazil.<br>➢ The utilization of aerated lagoons and polishing ponds are countless throughout the worlds. |
| 2. Required land area | Small | Large | Medium<br>➢ Aerated lagoons and polishing ponds can be constructed with the relatively deep depth. |
| 3. Construction cost | High | Low | Medium |
| 4. Operation and maintenance cost | | | |
| • Electricity consumption | ➢ Large, due to required for recirculation and others. | ➢ Not required. | ➢ Medium, because aerators request electricity. |
| • Easiness | ➢ Complicated | ➢ Easy | ➢ Medium |
| • Sludge generation and removal | ➢ Continuously draw-offed. | ➢ Periodical dredging every several years. | ➢ Periodical dredging every several years. |

## Table B.4-3 Treatment Process Applied for Priority STFs

| STFs | Biological Treatment System | | Sludge Treatment System | | |
|---|---|---|---|---|---|
| | RAFA + Bio-Filtration | RAFA + Aerated Lagoon + Polishing Pond | Sludge Digestion | Mechanical Dehydration | Natural Drying |
| Conceicao | | ● | | | ● |
| Janga | | ● | | | ● |
| Cabanga | ● | | ● | ● | |
| | ➢ The land area is very constrained. | | ➢ Existing Facilities will be used after being rehabilitated. | ➢ The land area is very constrained. | |
| Boa Viagem | | ● | | ● | |
| | | | | ➢ The site is adjacent to residential zone. | |
| Cordeiro | ● | | | ● | |
| | ➢ The available land area is limited due to the road and park construction plan. | | | ➢ The site is adjacent to residential zone. | |
| Prazeres | | ● | | | ● |
| Curcurana | | ● | | | ● |

# Table B.7-1 Major Operation Parameters in STFs

| Systems | Component Facilities | Check Parameters | STFs | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Conceicao | Janga | Cabanga | Boa Viagem | Cordeiro | Prazeres | Curcurana |
| Influent System | Coarse Bar Screen | Trapped screenings volume | ● | ● | ● | ● | ● | ● | ● |
| | | Water levels of pre-screen and post-screen | ● | ● | ● | ● | ● | ● | ● |
| | Grit Chamber | Grit collector running | ● | ● | ● | ● | ● | ● | ● |
| | | Settling grit volume | ● | ● | ● | ● | ● | ● | ● |
| | Fine Bar Screen | Trapped screenings volume | ● | ● | ● | ● | ● | ● | ● |
| | | Water levels of pre-screen and post-screen | ● | ● | ● | ● | ● | ● | ● |
| | Influent Pump | Pump running | ● | ● | ● | ● | ● | ● | ● |
| | | Discharged quantity | ● | ● | ● | ● | ● | ● | ● |
| Biological Treatment System | RAFA Distribution Box | Distributed sewage flow | ● | ● | ● | ● | ● | ● | ● |
| | RAFA Reactor | Distributed sewage flow | ● | ● | ● | ● | ● | ● | ● |
| | | Gas generation flow | ● | ● | ● | ● | ● | ● | ● |
| | | Accumulated sludge level | ● | ● | ● | ● | ● | ● | ● |
| | RAFA Sludge Draw-off Pump | Pump running | ● | ● | ● | ● | ● | ● | ● |
| | | Drawn sludge volume | ● | ● | ● | ● | ● | ● | ● |
| | Lagoon Distribution Box | Distributed sewage flow | ● | ● | | ● | | ● | ● |
| | Aerated Lagoon | Aerator running | ● | ● | | ● | | ● | ● |
| | Polishing Pond | Algae growth and scum generation | ● | ● | | ● | | ● | ● |
| | B/F Distribution Box | Distributed sewage flow | | | ● | | ● | | |
| | Bio-Filter | Spray arm running | | | ● | | ● | | |
| | | Odor generation | | | ● | | ● | | |
| | Recirculation Pump | Pump running | | | ● | | ● | | |
| | | Recirculation flow | | | ● | | ● | | |
| | Sedimentation Tank | Sludge collector running | | | ● | | ● | | |
| | | Scum generation | | | ● | | ● | | |
| | S/T Sludge Draw-off Pump | Pump running | | | ● | | ● | | |
| | | Drawn sludge volume | | | ● | | ● | | |
| Disaffection System | UV disinfection Unit | Unit running | ● | ● | ● | ● | ● | ● | ● |
| | Disinfection Tank | Treated sewage flow | ● | ● | ● | ● | ● | ● | ● |
| | Treated Sewage Outfall | Treated sewage flow | ● | ● | ● | ● | ● | ● | ● |
| | | Discharge water appearance | ● | ● | ● | ● | ● | ● | ● |
| Sludge Treatment System | Sludge Thickener | Sludge rake running | ● | ● | ● | ● | ● | ● | ● |
| | | Scum generation | ● | ● | ● | ● | ● | ● | ● |
| | Thickened Sludge Pump | Pump running | | | ● | ● | ● | | |
| | | Drawn sludge volume | ● | ● | ● | ● | ● | ● | ● |
| | | Sludge concentration | ● | ● | ● | ● | ● | ● | ● |
| | Sludge Digester | Sludge recircualtion pump running | | | ● | | | | |
| | | Gas generation | | | ● | | | | |
| | | Drawn sludge volume | | | ● | | | | |
| | | Drawn sludge supernatant | | | ● | | | | |
| | | Drawn sludge concentration | | | ● | | | | |
| | Gas Holder | Generated gas volume | | | ● | | | | |
| | Dehydrator | Dehydrator and related equipment running | | | ● | ● | ● | | |
| | | Dehydrated sludge quantity | | | ● | ● | ● | | |
| | | Sludge moisture | | | ● | ● | ● | | |
| | | Polymer coagulant consumption | | | ● | ● | ● | | |
| | | Polymer coagulant storage volume | | | ● | ● | ● | | |
| | Sludge Drying Bed | Dried sludge quantity | ● | ● | | | | ● | ● |
| | | Dried sludge moisture | ● | ● | | | | ● | ● |

**Remark:**

(1) Operation parameters necessary for respective STFs are shown by the mark "●".

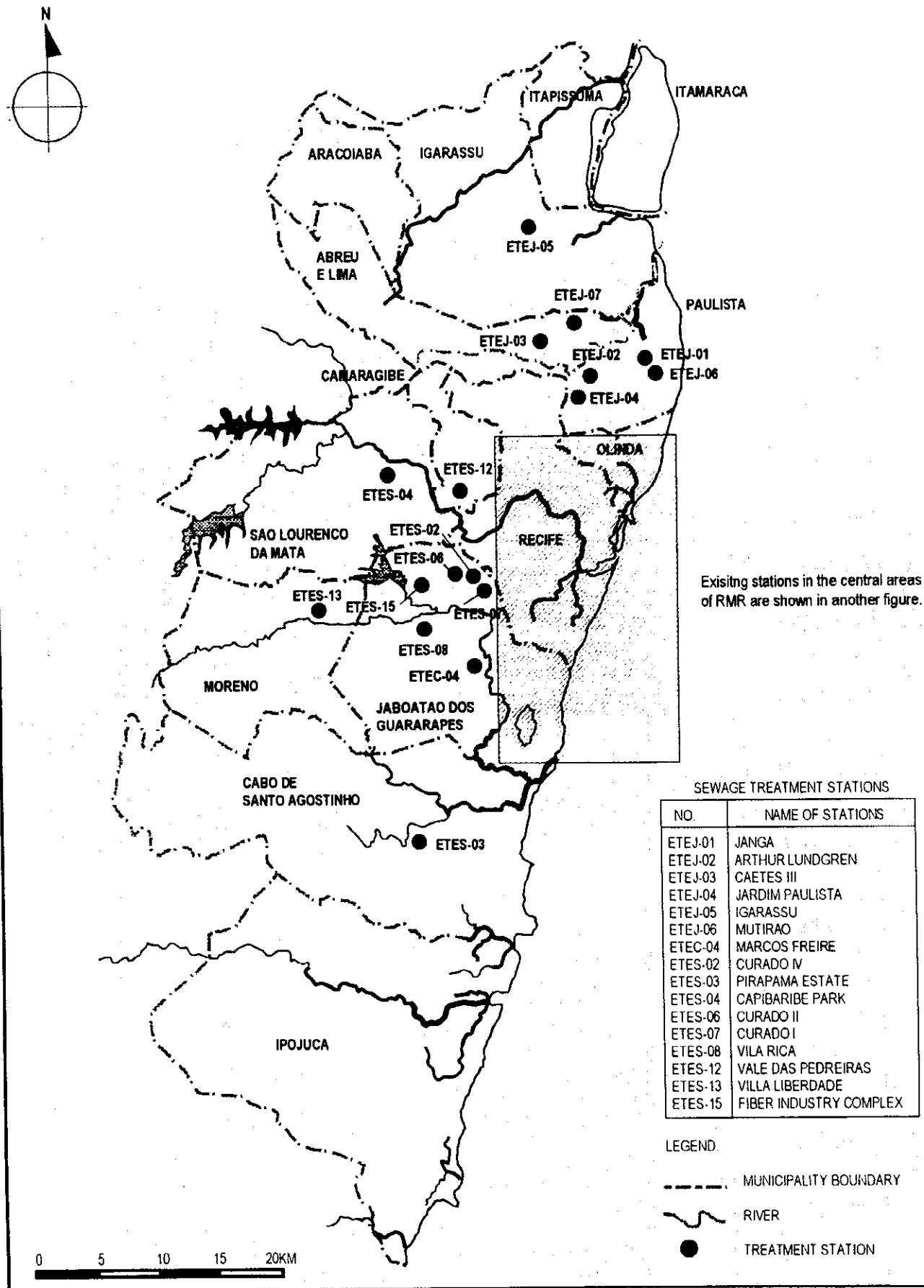



**Fig. B.1-1** | **Locations of Existing Sewerage Systems in Entire RMR**

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR

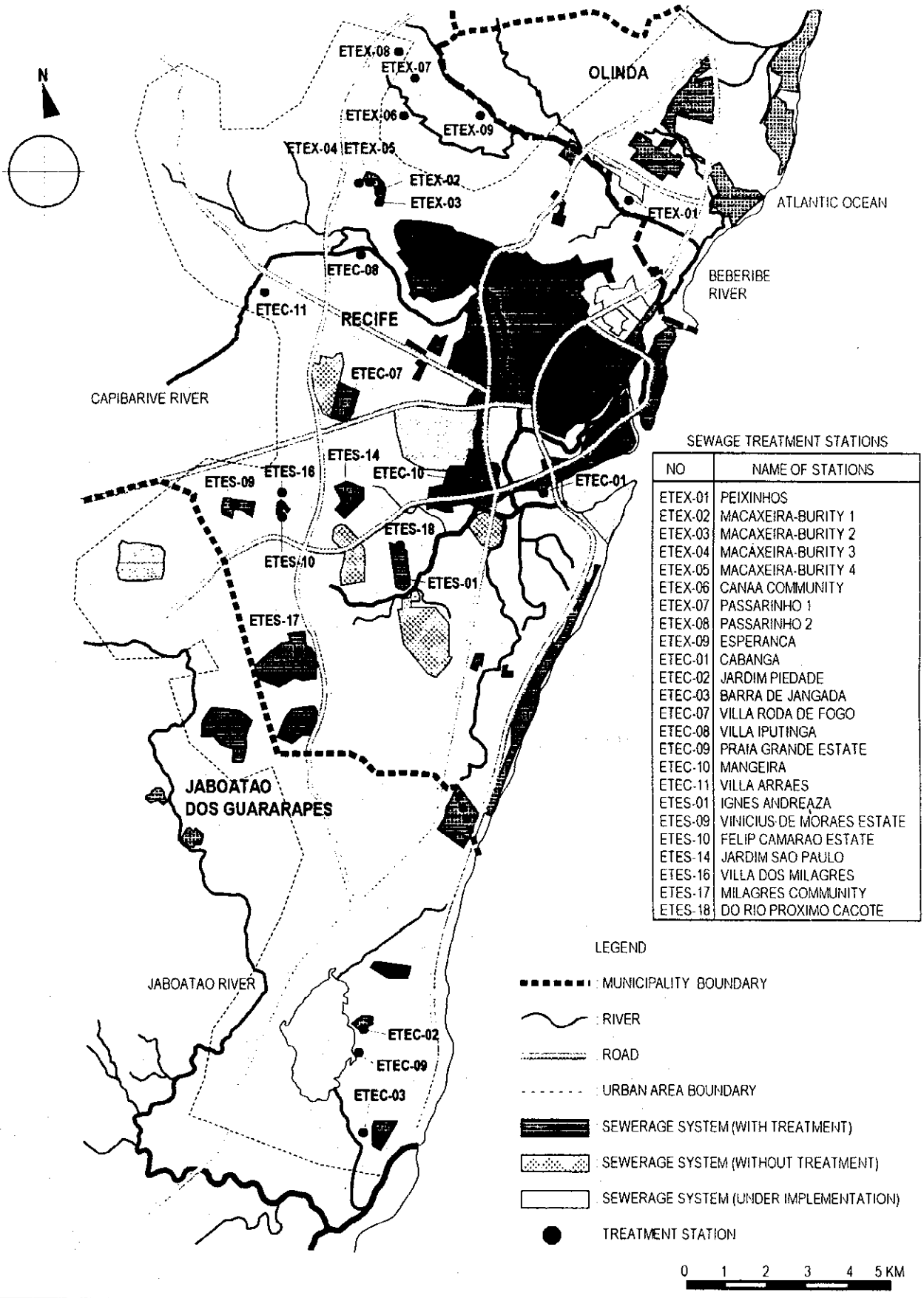



**Fig. B.1-2** **Locations of Existing Sewerage Systems in Central Area of RMR**

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR

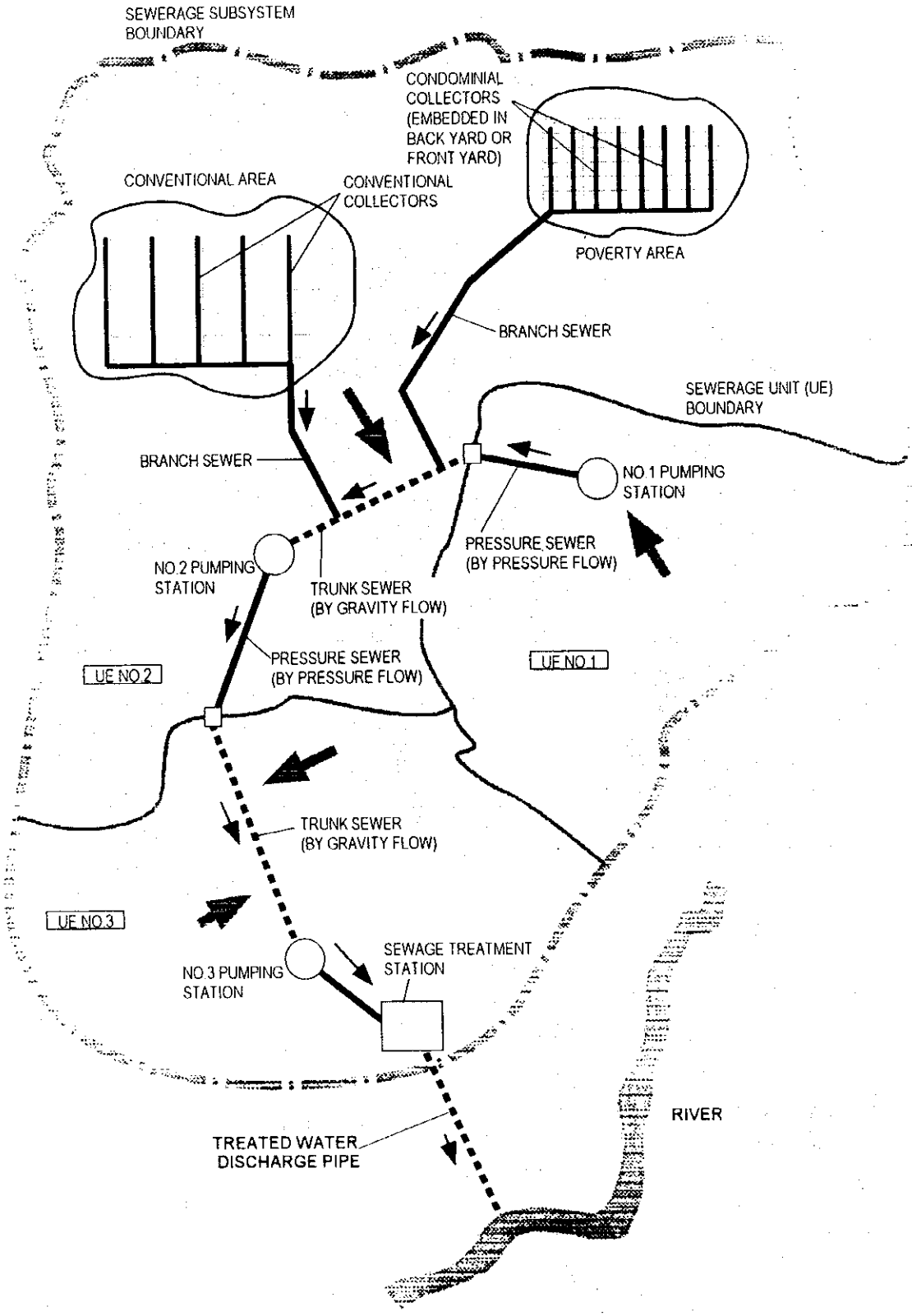
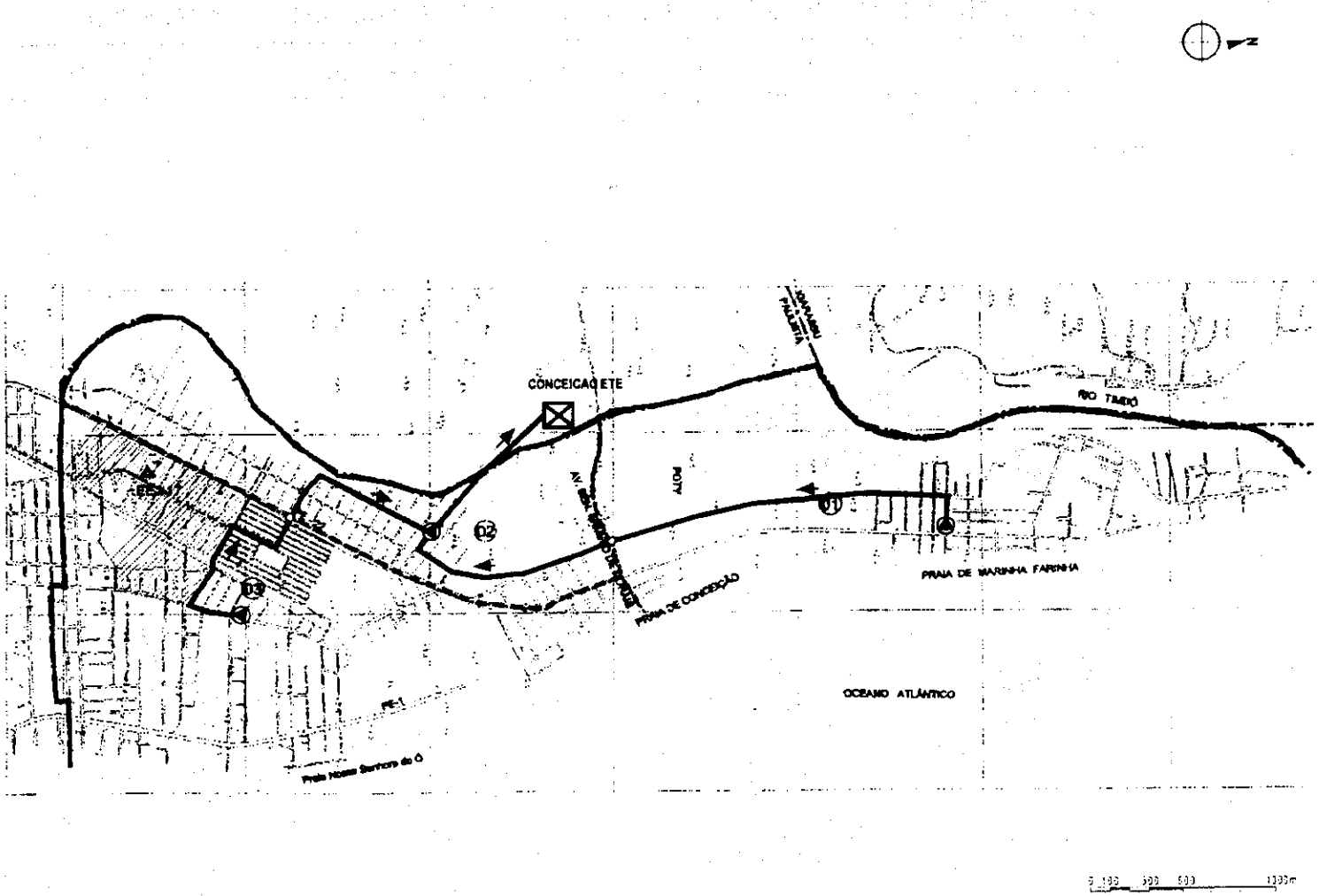
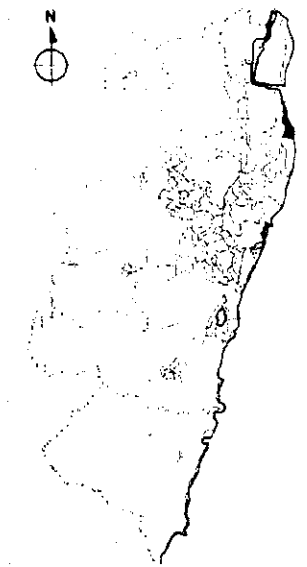



**Fig. B.2-1** **Conceptual Layout of Sewage Collection Facilities**

**THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR**




**LEGEND:**

- SEWERAGE SYSTEM BOUNDARY
- SEWERAGE UNIT (UE) BOUNDARY
- SEWERAGE UNIT (UE) NUMBER
- PROPOSED TRUNK OR PRESSURE SEWER
- EXISTING MAJOR SEWERS
- PUMPING STATION
- MANEHOLE OR SEWAGE SUMP
- SEWAGE TREATMENT STATION
- SEWAGE FLOW DIRECTION
- EXISTING PUMPING STATION
- AREA COVERED BY EXISTING SEWER NETWORKS

**NOTE**

ONLY TRUNK AND PRESSURE SEWERS ARE SHOWN IN THIS DRAWING

| Fig. B.2-2 | Overall Layout Plan of Conceicao System |
|---|---|

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR

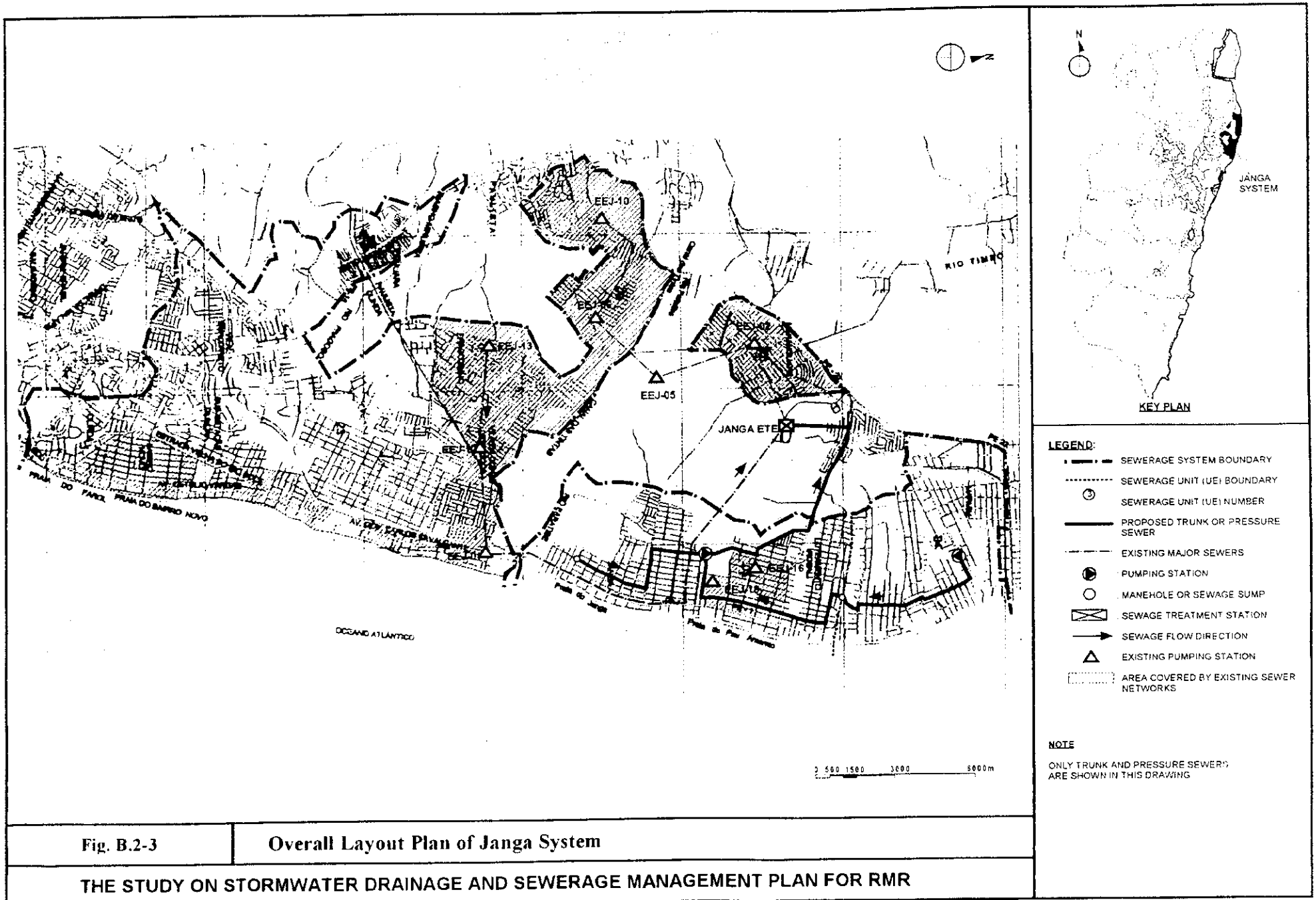
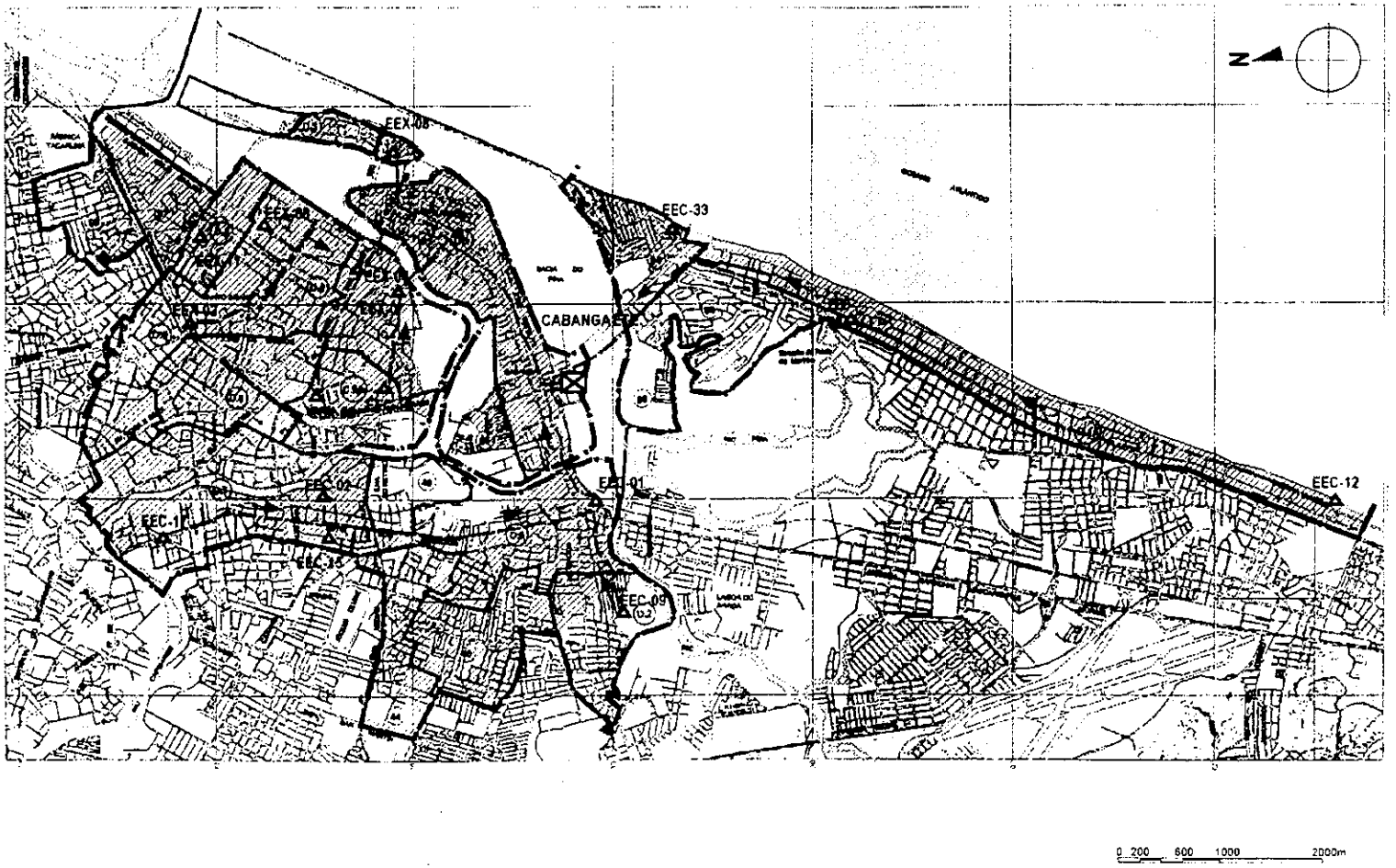
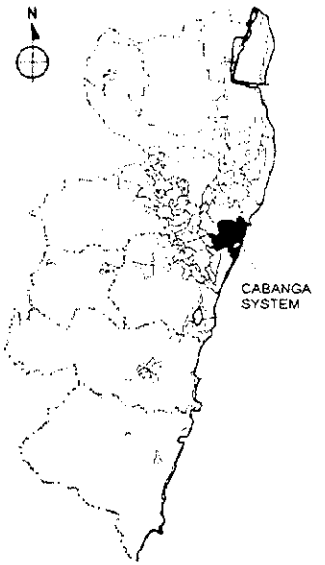



**Fig. B.2-3** **Overall Layout Plan of Janga System**

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR




LEGEND:

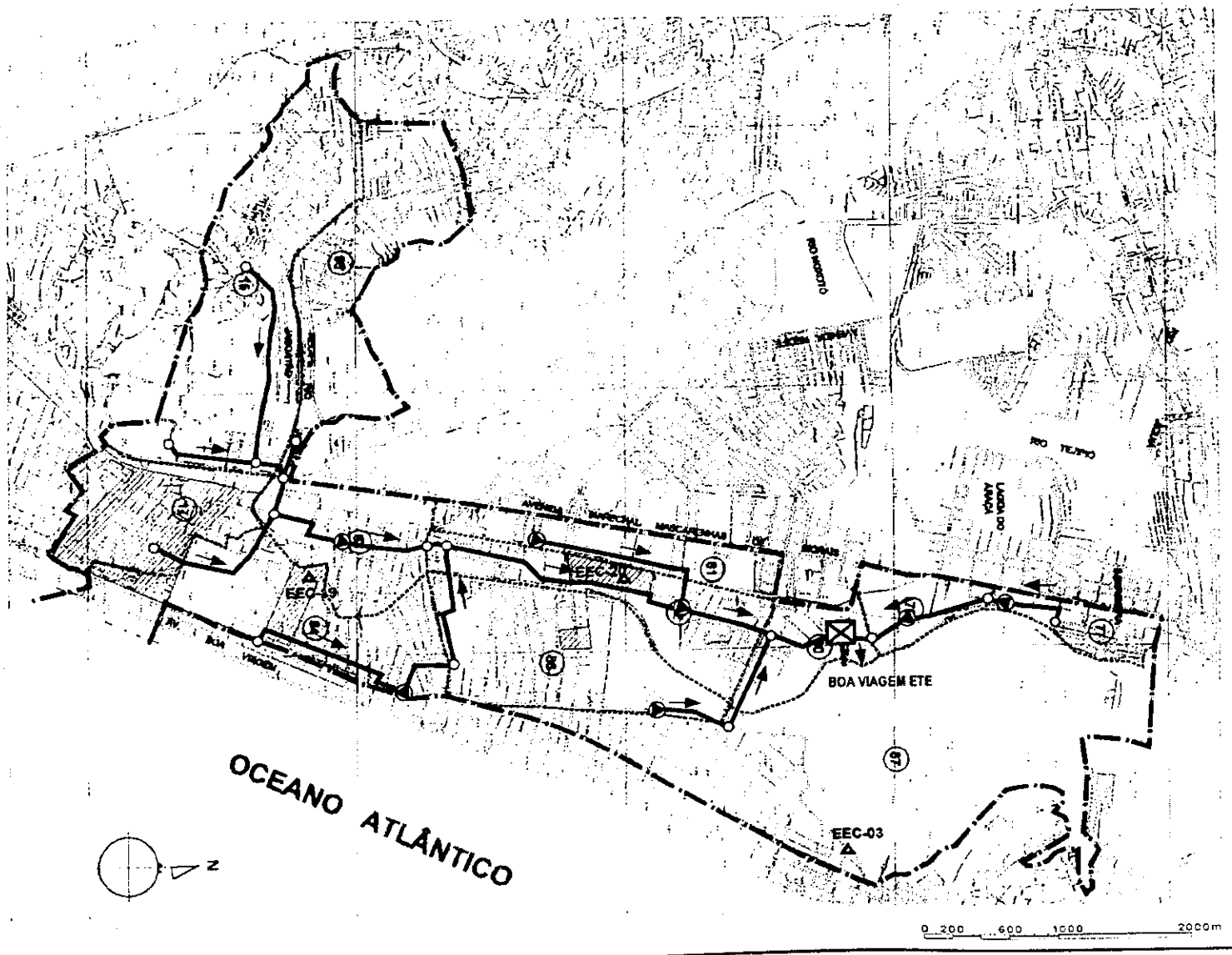
- SEWERAGE SYSTEM BOUNDARY
- SEWERAGE UNIT (UE) BOUNDARY
- SEWERAGE UNIT (UE) NUMBER
- PROPOSED TRUNK OR PRESSURE SEWER
- EXISTING MAJOR SEWERS
- PUMPING STATION
- MANEHOLE OR SEWAGE SUMP
- SEWAGE TREATMENT STATION
- SEWAGE FLOW DIRECTION
- EXISTING PUMPING STATION
- AREA COVERED BY EXISTING SEWER NETWORKS

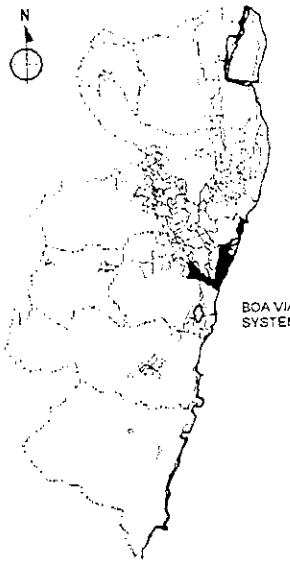
NOTE

ONLY TRUNK AND PRESSURE SEWERS ARE SHOWN IN THIS DRAWING

| Fig. B.2-4 | Overall Layout Plan of Cabanga System |
|---|---|

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR




KEY PLAN

LEGEND:

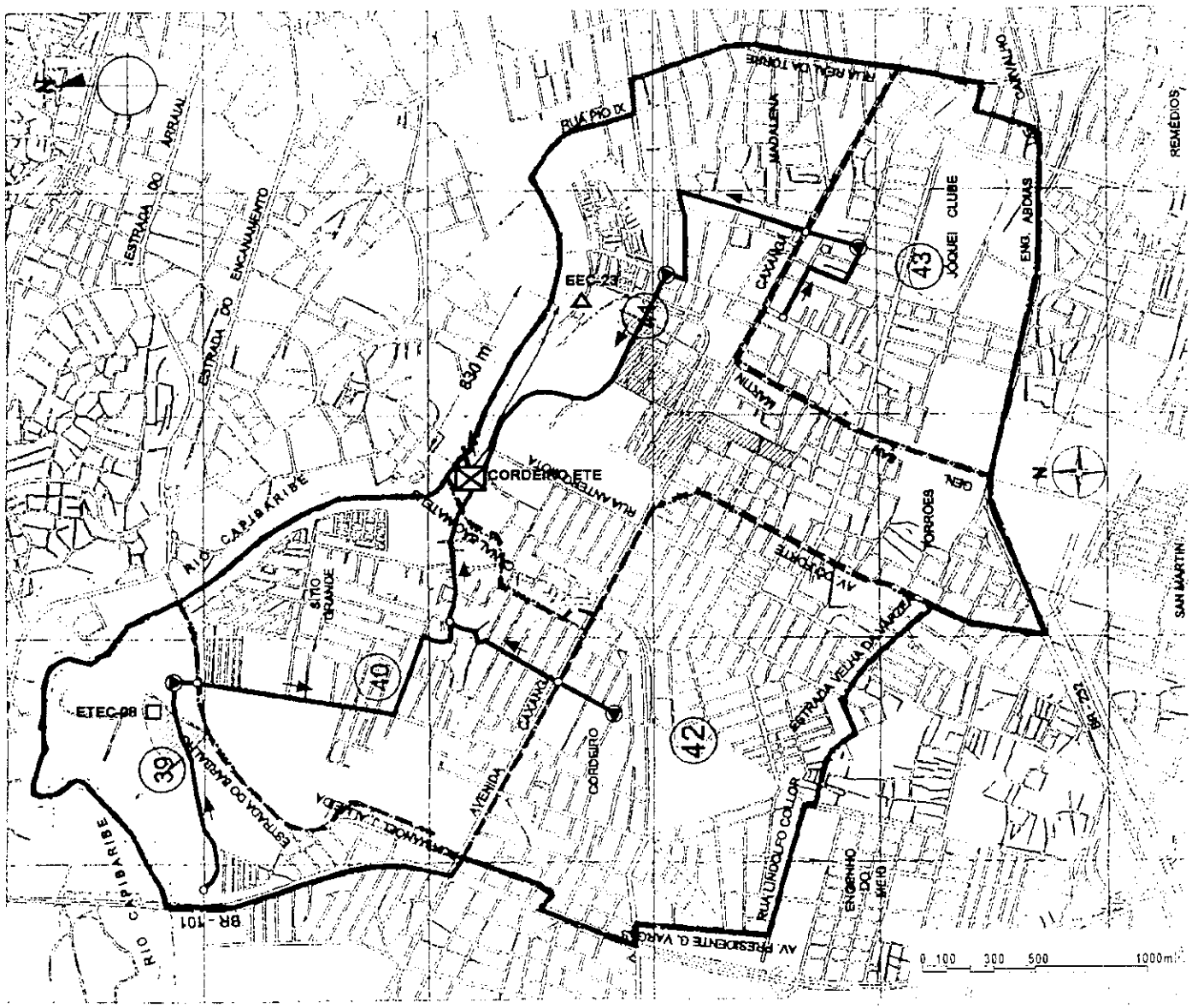
- SEWERAGE SYSTEM BOUNDARY
- SEWERAGE UNIT (UE) BOUNDARY
- SEWERAGE UNIT (UE) NUMBER
- PROPOSED TRUNK OR PRESSURE SEWER
- EXISTING MAJOR SEWERS
- PUMPING STATION
- MANEHOLE OR SEWAGE SUMP
- SEWAGE TREATMENT STATION
- SEWAGE FLOW DIRECTION
- EXISTING PUMPING STATION
- AREA COVERED BY EXISTING SEWER NETWORKS

NOTE

ONLY TRUNK AND PRESSURE SEWERS ARE SHOWN IN THIS DRAWING

**Fig. B.2-5** **Overall Layout Plan of Boa Viagem System**

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR




| Fig. B.2-6 | Overall Layout Plan of Cordeiro System |
|---|---|

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR

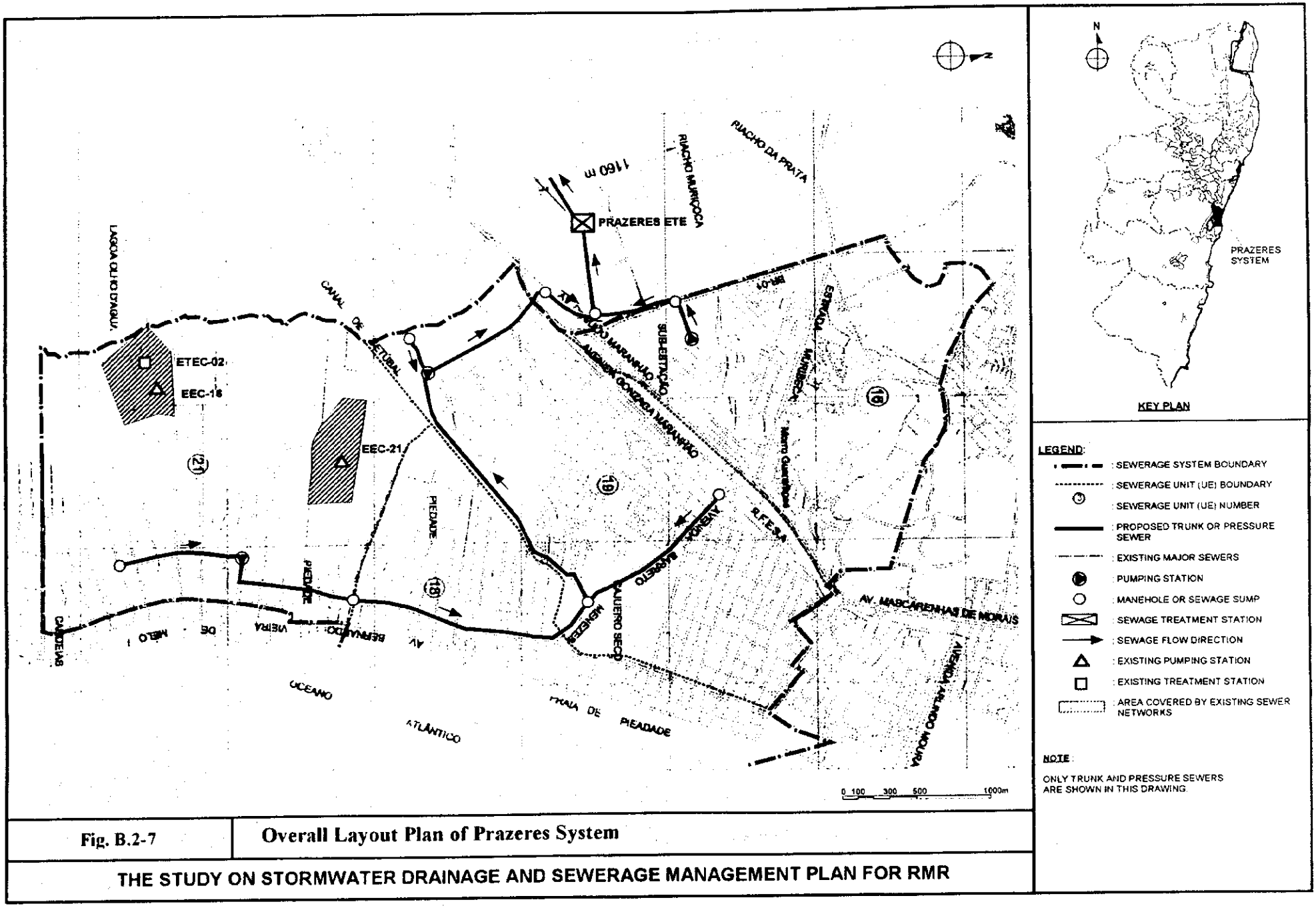
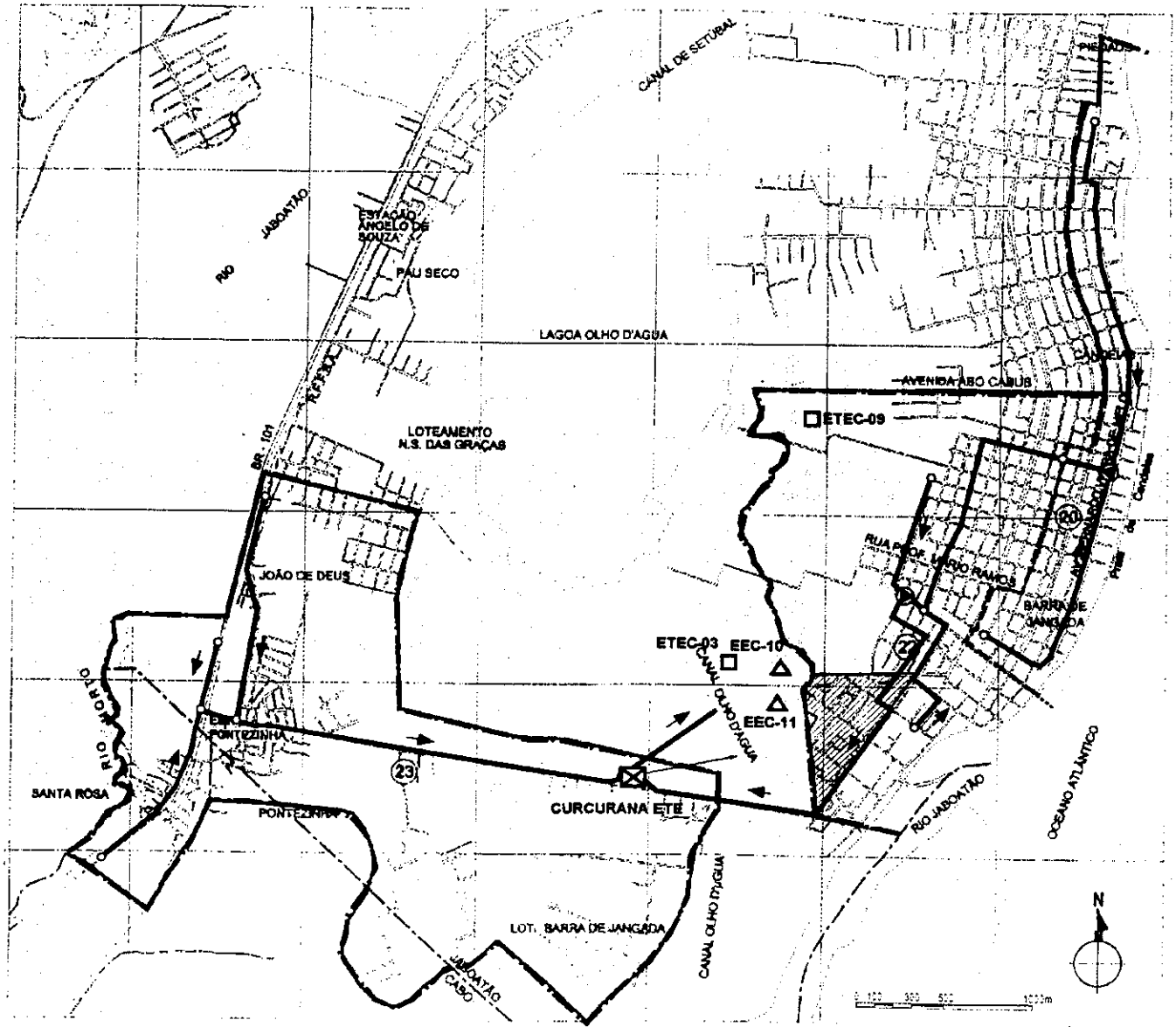
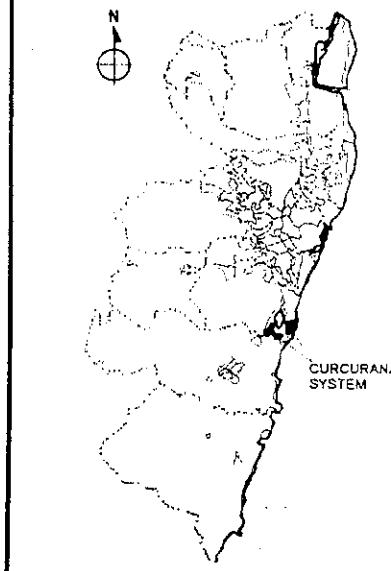



**Fig. B.2-7** **Overall Layout Plan of Prazeres System**

**THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR**




KEY PLAN

LEGEND:

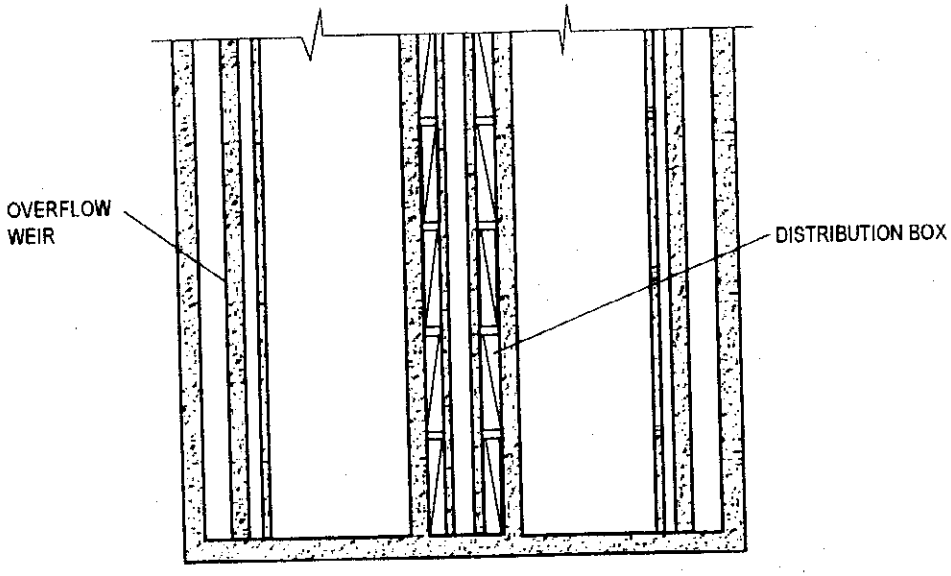
- : SEWERAGE SYSTEM BOUNDARY
- : SEWERAGE UNIT (UE) BOUNDARY
- ③ : SEWERAGE UNIT (UE) NUMBER
- : PROPOSED TRUNK OR PRESSURE SEWER
- : EXISTING MAJOR SEWERS
- : PUMPING STATION
- : MANEHOLE OR SEWAGE SUMP
- : SEWAGE TREATMENT STATION
- : SEWAGE FLOW DIRECTION
- : EXISTING PUMPING STATION
- : EXISTING TREATMENT STATION
- : AREA COVERED BY EXISTING SEWER NETWORKS

NOTE

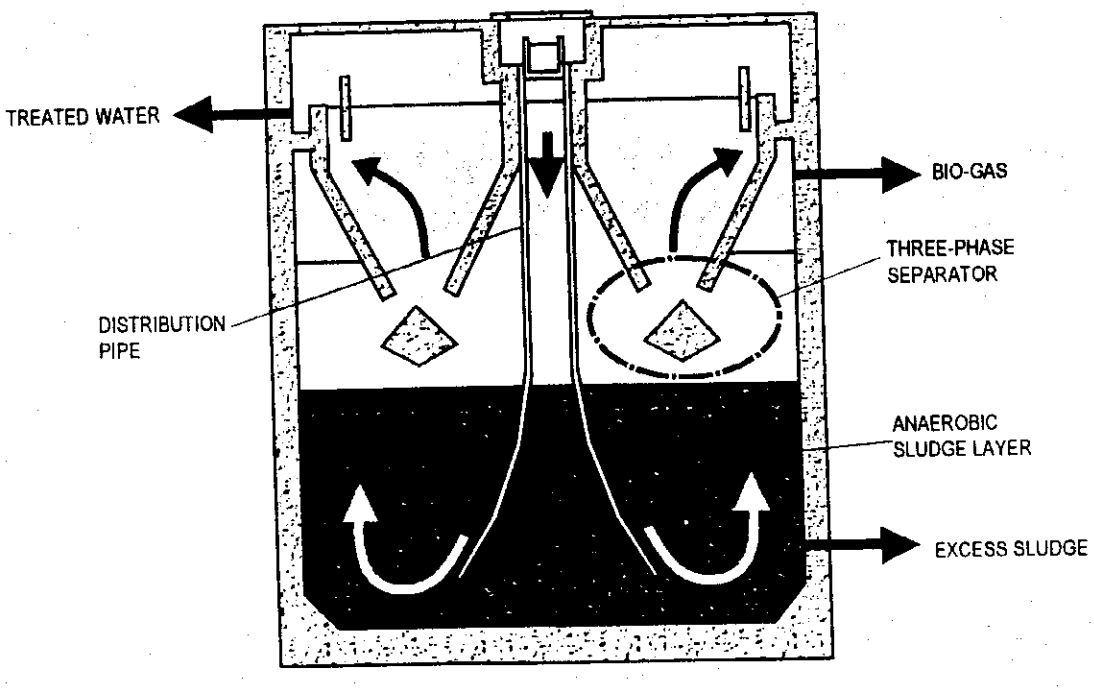
ONLY TRUNK AND PRESSURE SEWERS ARE SHOWN IN THIS DRAWING

**Fig. B.2-8** **Overall Layout Plan of Curcurana System**

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR




PLAN VIEW




SIDE VIEW

NOTE: RAFA IS THE ABBREVIATION OF REATOR ANAEROBICO DE FLUX ASCENDENTE (UPFLOW ANAEROBIC SLUDGE BLANKET) IN PORTUGUESE.

| Fig. B.2-9 | Typical Configuration of RAFA Reactor |
|---|---|

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR

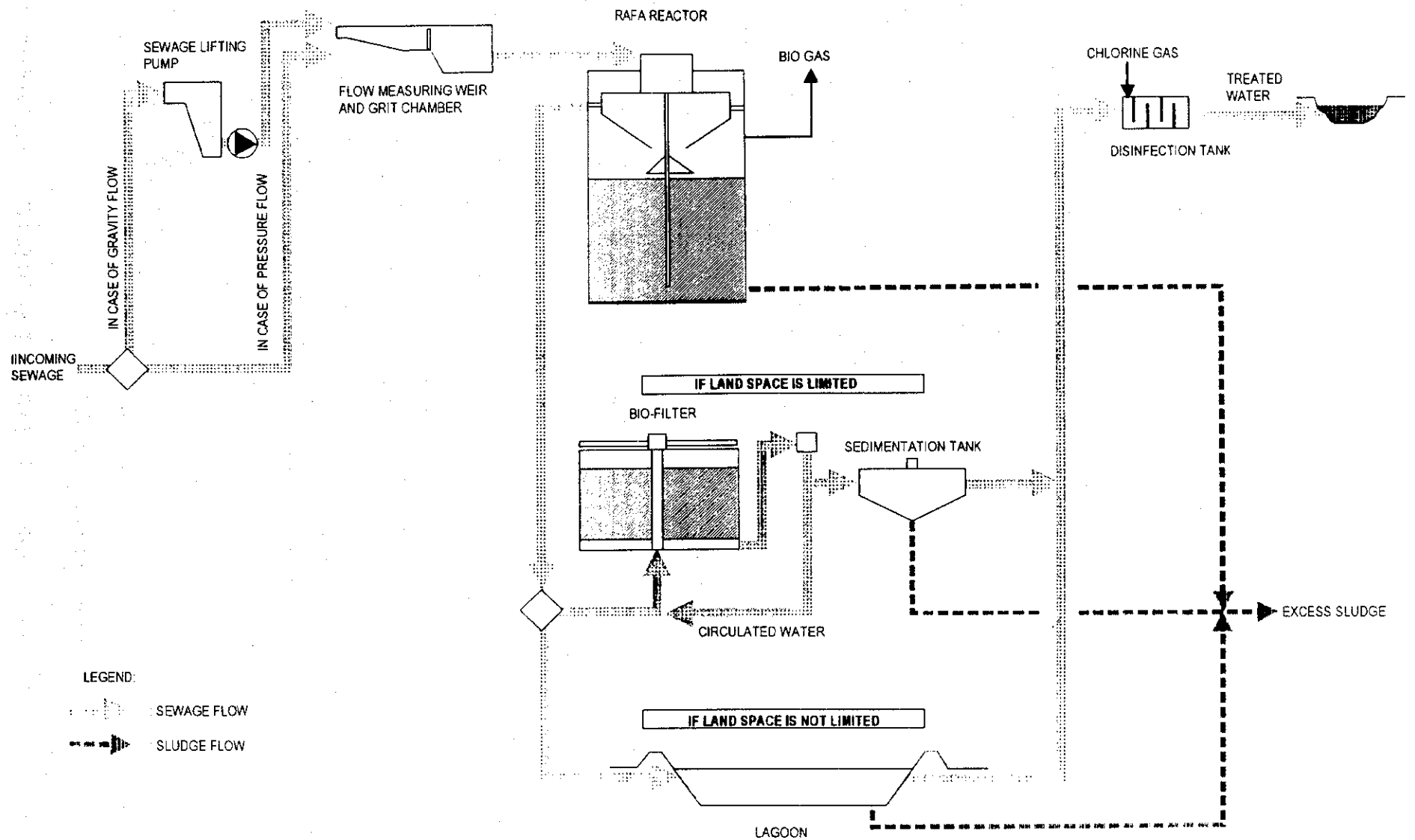



**Fig. B.2-10** **Flow Diagram of Combined RAFA Process**

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR

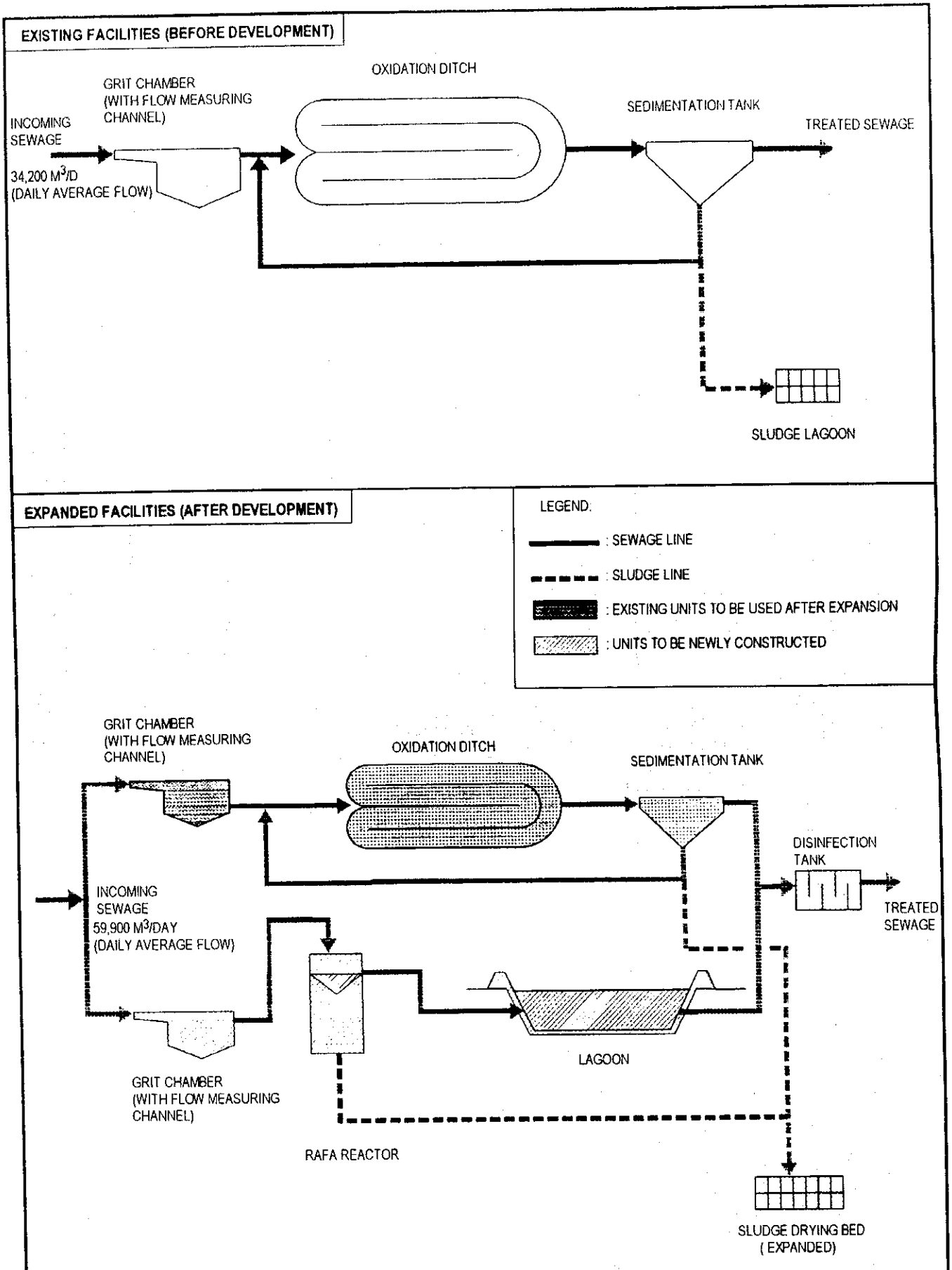



**Fig. B.2-11** **Flow Diagram of Janga STF**

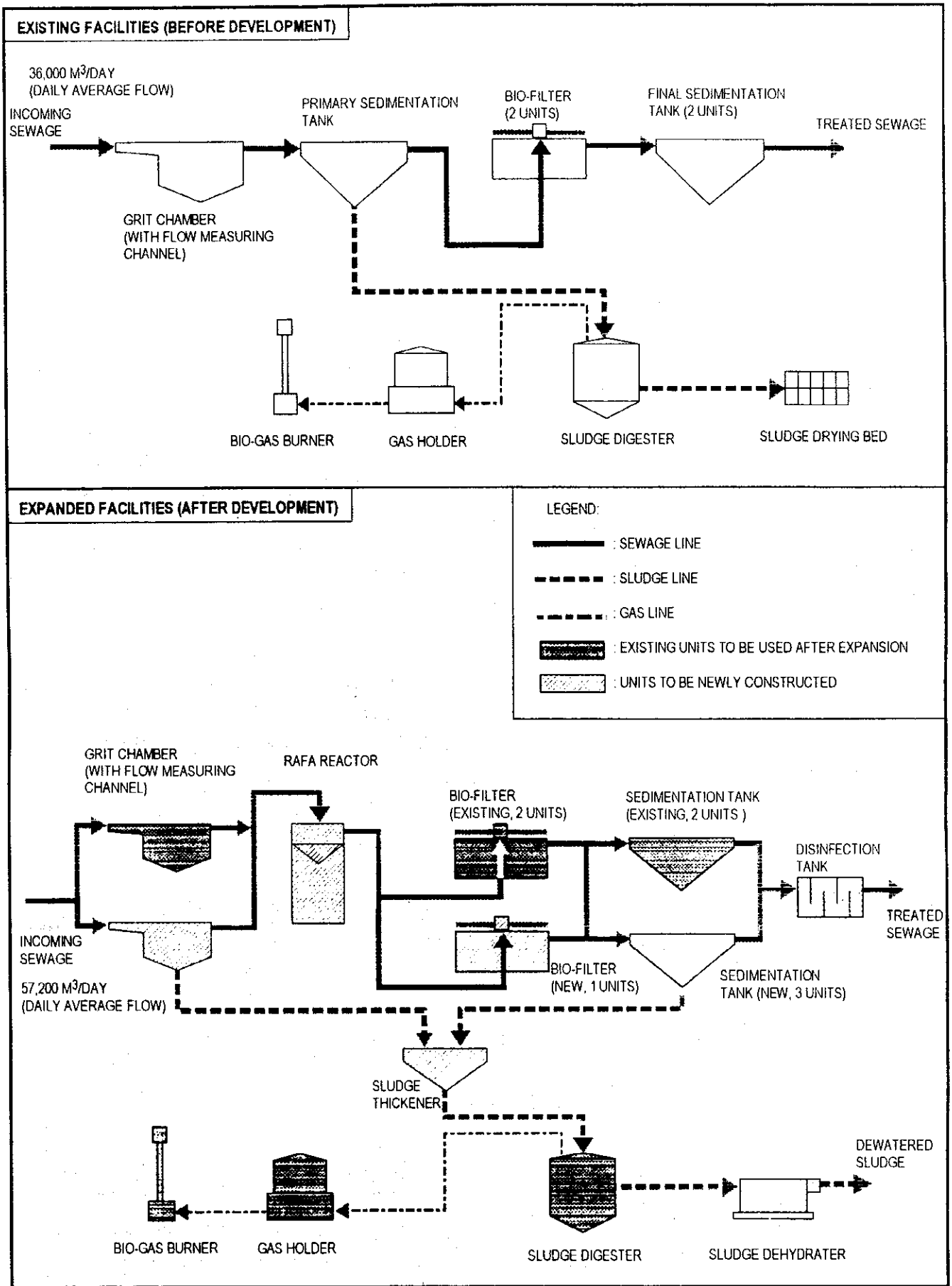



**Fig. B.2-12** **Flow Diagram of Peixinhos STF**

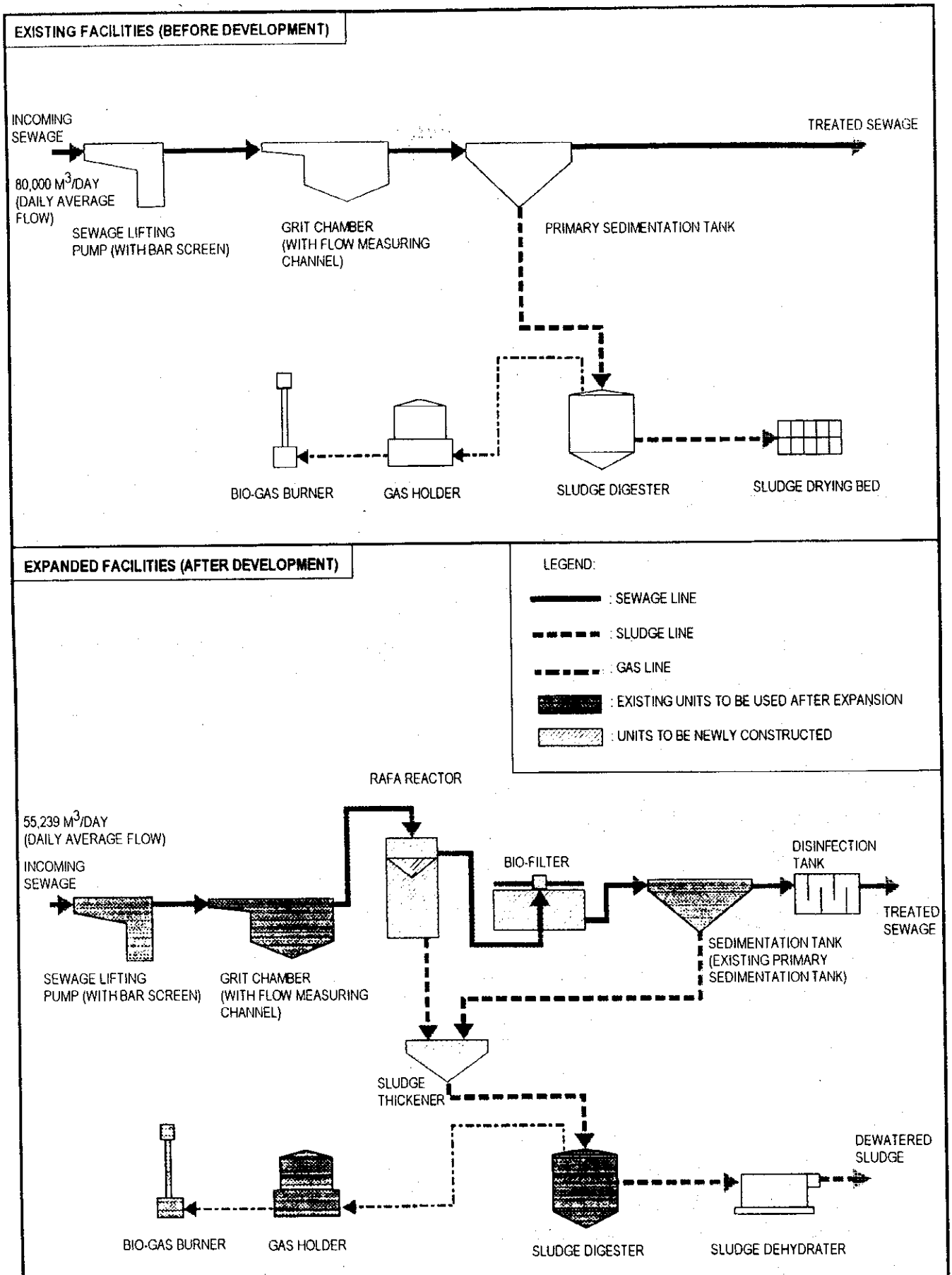



**Fig. B.2-13** **Flow Diagram of Cabanga STF**

**THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR**

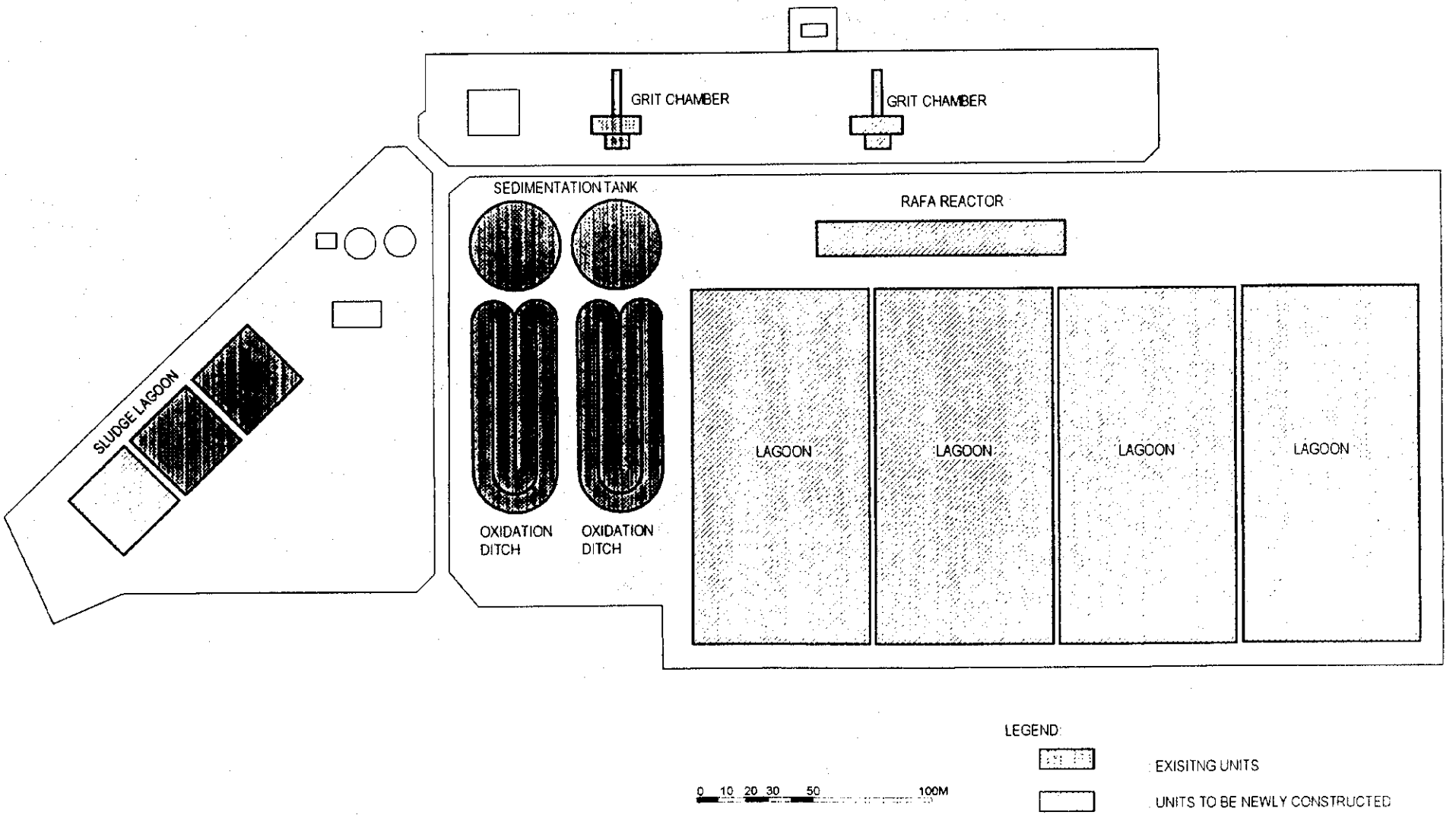



**Fig. B.2-14** **Layout Plan of Janga STF**

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR

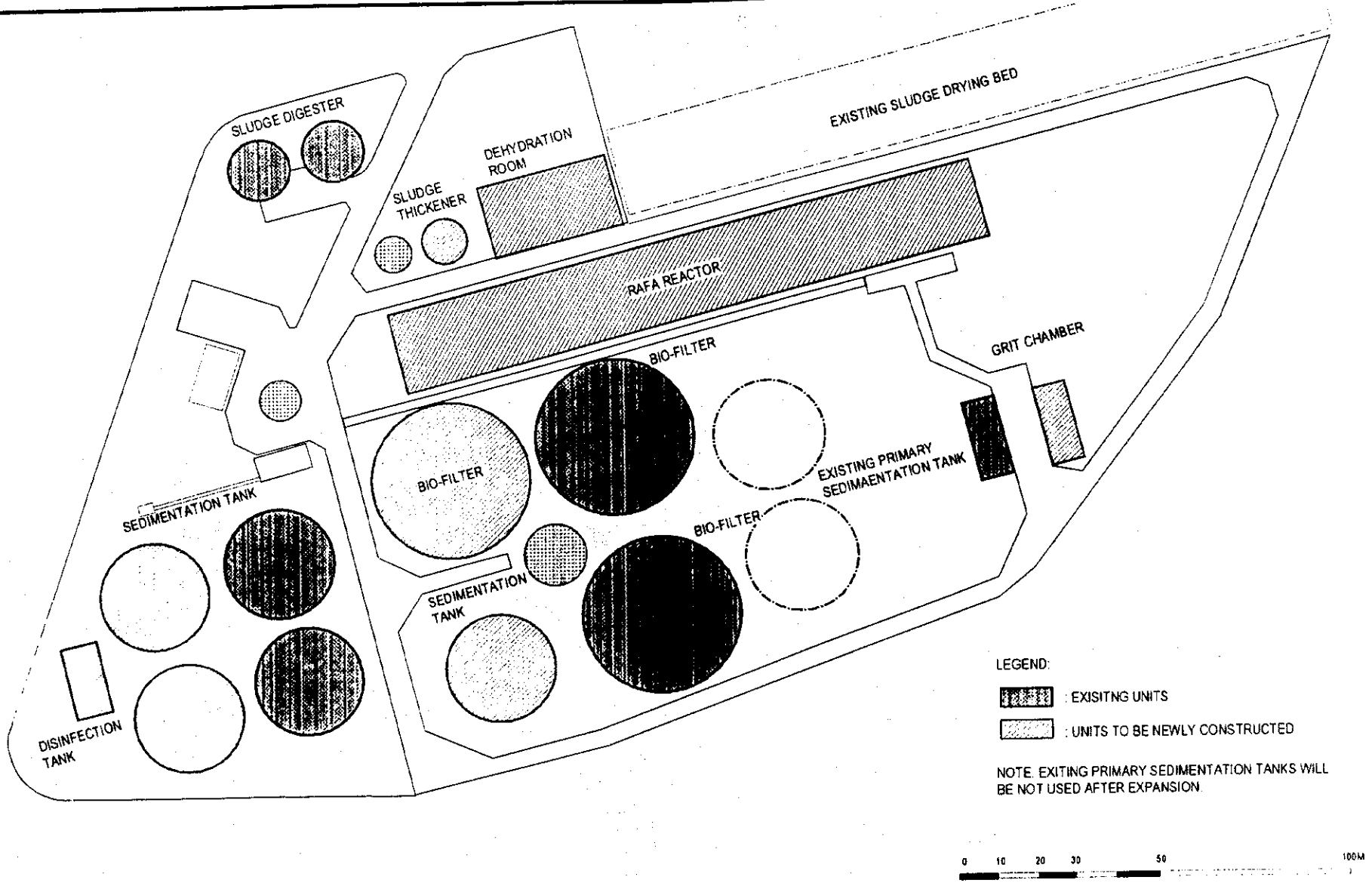



**Fig. B.2-15** **Layout Plan of Peixinhos STF**

**THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR**

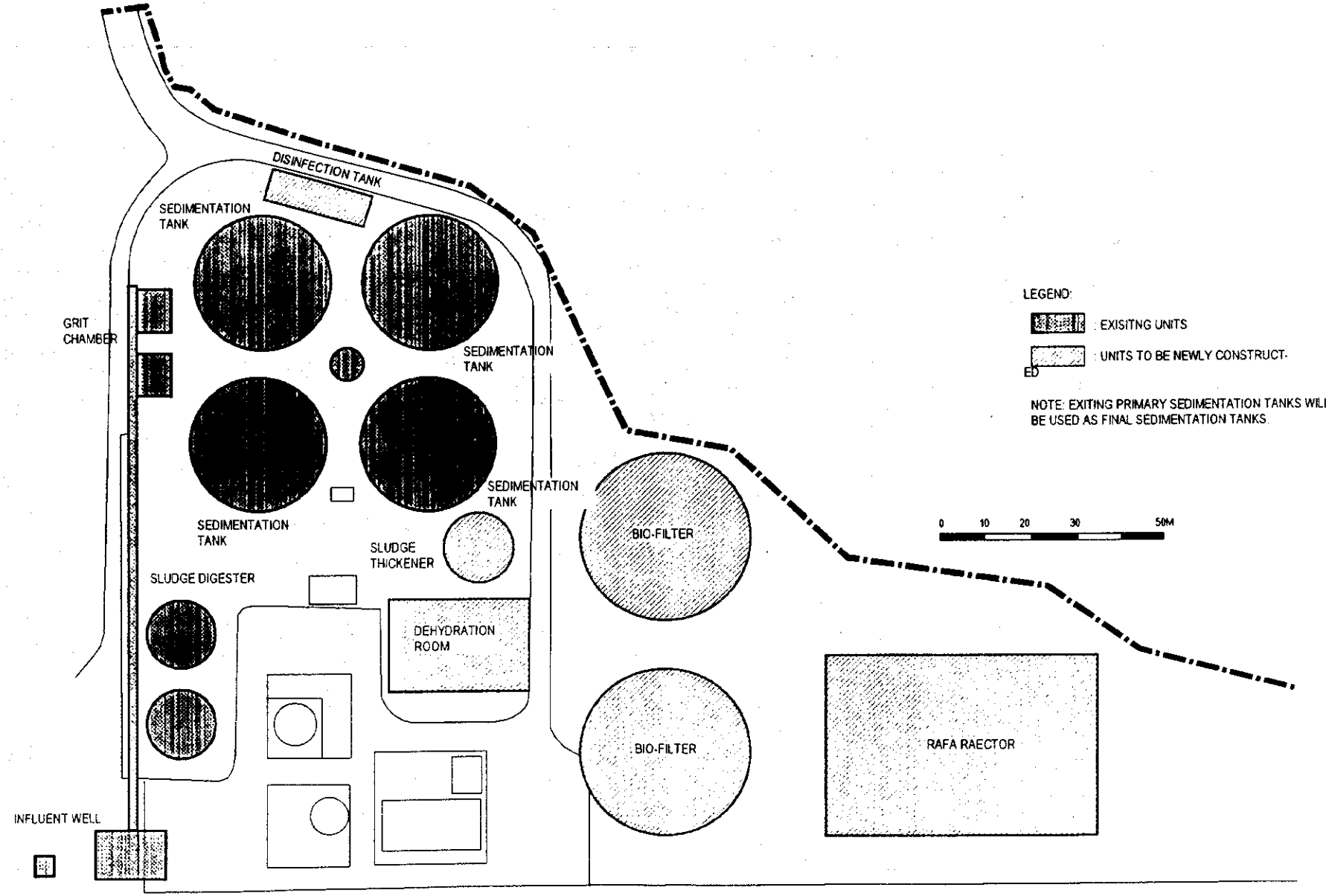
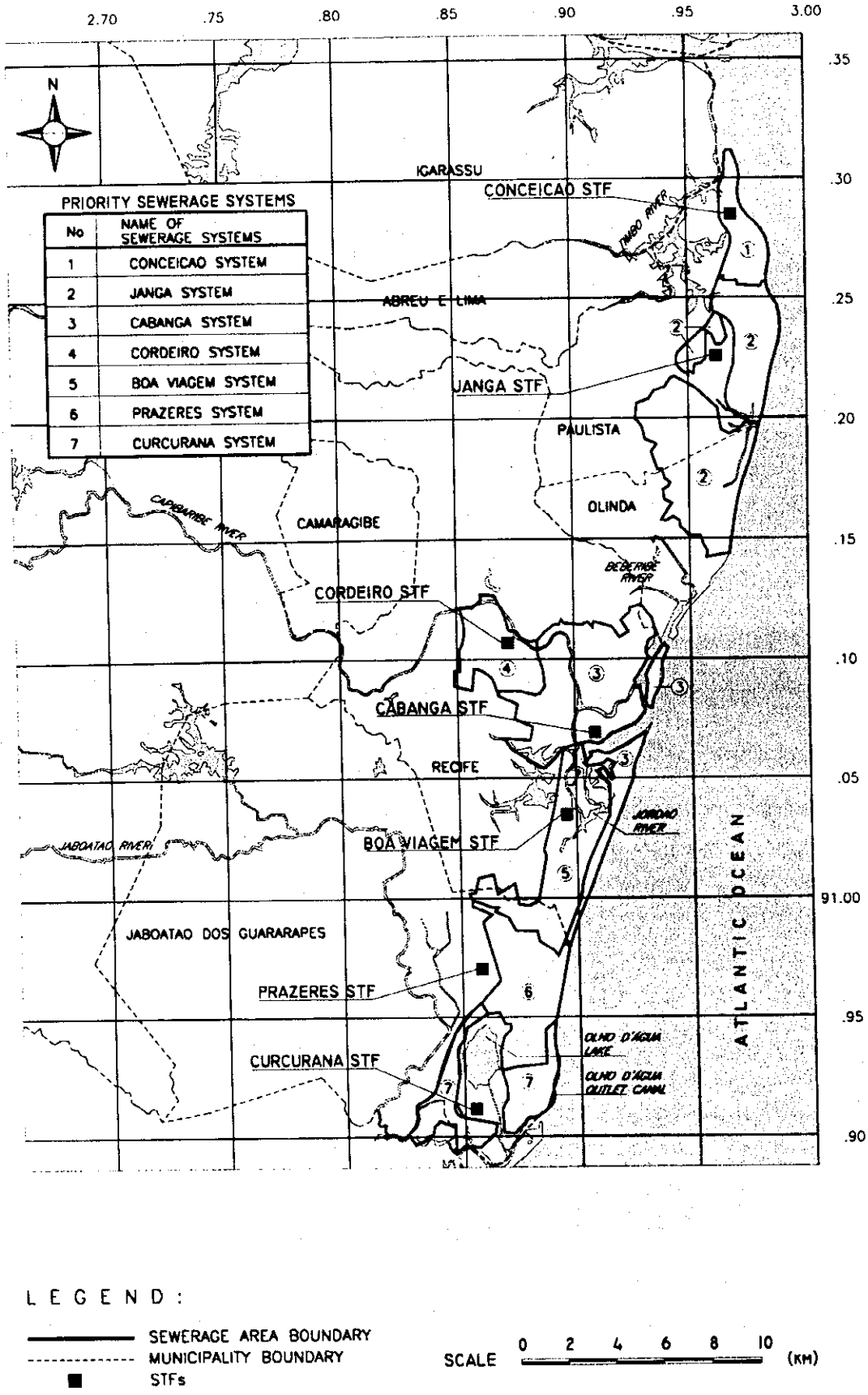



**Fig. B.2-16** **Layout Plan of Cabanga STF**

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR




| Fig. B.3-1 | Location of Priority Sewage Treatment Facilities |
|---|---|

THE STUDY ON STORMWATER DRAINAGE AND SEWERAGE MANAGEMENT PLAN FOR RMR