case was broken down to the operation component of 20.78 FCFA and the value added tax of 1.45 FCFA adding up to 22.23 FCFA per $m^3$. When we put together 366.92 FCFA and 22.23 FCFA, we get the normal section tariff of 389.15 FCFA per $m^3$ in the sewered area.

It is evident from the above that the water tariff was so structured that it might cover not only the operation cost, but also the repayment cost, replacement/expansion cost, taxes and sewerage cost.

### 1.2.6 Future Development Plans

In this section, various future plans regarding the sewerage system in the Study Area are reviewed. Two main studies, viz. Water Supply and Sanitation Master Plan 1973 and Strategy Plan of Sanitation 1991, are described first and followed by a few improvement plans proposed by SONEES since 1991.

1) Water Supply and Sanitation Master Plan 1973 (PLAN DIRECTEUR, DAKARET SES ENVIRONS, APROVIONNEMENT EN EAU ET ASSAINISMENET)

The first comprehensive sewerage master plan was prepared in 1973 by NEDECO and LA HAYE. UNDP funded the study on the request of the Senegal Government.

The study consists of three subjects, viz. water supply, sanitary sewerage and storm water drainage. The study covers Rufisque in addition to Dakar and Pikine, which are the study area of the current study. The target year of the study is the year 2000. The basic conditions in the study area in 1968, and estimation in 2000 are summarized as follows:

| | 1968 | 2000 |
|---|---|---|
| Population | 632,000 | 3,242,000 |
| - by house connection | (205,400) | (947,000) |
| | (32.5 %) | (29.2 %) |
| - by stand pipe | (426,600) | (2,295,000) |
| | (67.5 %) | (70.8 %) |
| Per-capita water consumption (lpcd) | | |
| - House connection | 77 | 84 |
| - Standpipe | 19 | 22.5 |
| - Average | 37.6 | 40.6 |
| Water consumption ($m^3$/day) | | |
| - Domestic | 23,760 | 131,543 |
| - House connection | (15,752) | (79,906) |
| - Standpipe | (8,008) | (51,637) |
| - Non-domestic | 32,240 | 127,265 |
| - Total | 56,000 | 258,185 |

Based on the present conditions (1968) and estimation mentioned above, the study proposed a sanitary sewerage system as shown in *Figure* B.1.11. Apparently indicated in the figure, sewerage system does not cover all the urbanized areas in 2000. On-site sanitary systems, which though not described in the report, are proposed for the remaining areas, such as Pikine Irregular and a huge new development area northeast of Rufisque. All the wastewater collected by the sewer networks is to be discharged to the sea at a few centralized points. Treatment of wastewater before being discharged into the sea is not considered in the study.

It has been more than 20 years since the preparation of the study. Many deviations from the estimations are recognized in the Study Area. Therefore, proposals made by the study should be reconsidered.

2) Strategy Plan of Sanitation 1991 (PLAN DE STRATEGIE D'ASSAINISSEMENT POUR LA COMMUNAUTE URBAINE DE DAKAR)

The Strategy Plan has been prepared to cope with the present problems in the field of sanitation and urban drainage in the Study Area. The plan was prepared in 1991 by BETUTURE and

SETAME/SONED AFRIQUE consultant under the supervision of the World Bank, and financed by UNDP.

The Plan consists of two parts, viz. Mission 1 which deals with the present conditions and problems, and projections of population up to the year 2010, and Mission 2 which proposes the strategy for sanitation and urban drainage systems for 2010.

Present conditions in the Study Area were investigated in detail analyzing many aspects, such as socio-economic, urbanization, climatic, hydrogeologic, water supply, sanitation systems, agriculture, institutional and financial aspects. In particular, the entire urban area in the Study Area was divided into small units each of which had similar housing characteristics. Water supply and sanitation conditions were analyzed for each unit.

Future population projection were made for units based on the demographic trend observed in the Study Area and the development condition of each unit. Future wastewater quantities were estimated based on the population projection and water supply conditions in the Study Area. The latest water supply master plan and its implementation program are properly reflected in the Plan. Therefore, the projections of population and wastewater quantities in this report can be considered as the basis for the current Study.

Five scenarios were proposed to improve the sanitary condition in the Study area. These are as follows:

Scenario 1: Improvement of on-site system. Provision of septic tanks of water-tight construction with a pit or pipes for seepage.

Scenario 2: Small bore sewer system or individual treatment system. This scenario was proposed for the houses whose water consumption is between 20 to 40 lpcd. In case of small bore sewer systems, wastewater flows into a septic tank and a part of effluent discharges into a small diameter sewer and the remaining part infiltrate into the soil. Wastewater treatment by utilizing large water plants, such as water lettuce, is proposed for the individual treatment system.

Scenario 3: Connection to the existing sewerage system. This scenario was developed for the housing area where public sewers are already available.

Scenario 4: Construction of new sewer networks. This scenario was proposed for the existing high standard housing areas, newly developed housing areas and industrial areas.

Scenario 5: Extension of treatment capacity. This scenario is the result of scenarios 3 and 4.

The Study Area was divided into 7 sanitary districts based on the present sanitary facilities, sewerage networks in particular, and characteristics of the areas, such as housing type. Five scenarios mentioned above were applied to each sanitary district taking into account the physical and socio-economic conditions of the units included in the districts. Division of sanitary districts and application of the scenarios are as follows and shown in *Figure* B.1.12.

| Sanitary District | Areas |
|---|---|
| 1 | Terre-Sicap, Sud Bourguiba |
| 2 | Villages |
| 3 | Almadies and West Coast |
| 4 | Port and Industrial Zone |
| 5 | Parcelles Assainies, Patte d'Oie, Grand Yoff |
| 6 | Pikine, Guediawaye, Thiaroye |
| 7 | Mbao free zone |

Proposed Scenario for Each District

| Sanitary District | SC.1 | SC.2 | SC.3 | SC.4 | SC.5 |
|---|---|---|---|---|---|
| 1 | X | | XXX | X | X |
| 2 | XXX | X | | | X |
| 3 | X | X | | XXX | |
| 4 | X | X | | XXX | XXX |
| 5 | X | X | | XXX | XXX |
| 6 | XXX | X | X | X | X |
| 7 | individual or communal treatment of industrial wastewater | | | | |

Note: XXX For most of the units
X For a small number of units

When the scenarios are realized, the total and sewered population in 2010 will be as follows:

| Sanitary District | 1989 | | | 2010 | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 |
| 1 | 375,011 | 0.869 | 325,769 | 638,251 | 0.923 | 589,645 |
| 2 | 221,891 | 0 | 0 | 501,513 | 0.018 | 9,220 |
| 3 | 34,534 | 0.241 | 8,328 | 79,478 | 0.693 | 48,018 |
| 4 | 2,220 | 0 | 0 | 9,630 | 0.110 | 963 |
| 5 | 195,673 | 0.289 | 56,557 | 512,297 | 0.689 | 352,157 |
| 6 | 462,305 | 0.024 | 11,061 | 814,297 | 0.154 | 125,188 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 1,291,634 | 0.311 | 401,715 | 2,555,466 | 0.440 | 1,125,191 |

Note : 1. Total Population
2. Connection Rate
3. Sewered Population

Realization of the proposal will increase sewered population by 723,476 in 2010. This is a significant increase considering the current progress of improvement of the sewerage system in the Study Area. However, connection rates will rise from 31.1 % in 1989 to 44.0 % in 2010, only a 12.9 % increase, and more than a half of the population will not have access to the sewerage system. The main reason for this is the rapid population growth in the Study Area, which is expected double in 21 years. Projection of the sewered population can be said to be ambitious, but still realistic, taking into account the growing recognition of the need for sanitation system improvement, and the sewerage system in particular.

Five hypotheses were considered as for the level of water consumption rates, progress of sewerage projects and sewer connection rates in order to analyze the effects of these on the sanitation condition in the Study Area. All the five hypotheses were based on the same population projection. The hypotheses are described briefly in the following.

Hypothesis 1 Per-capita water consumption is fixed at the present value. No sewerage project will be implemented. Sewer connection rates will not change. Hypothesis 1 is the most pessimistic one which envisages the completion of the Cayor Canal after 2010.

Hypothesis 2 Per-capita water consumption and no sewerage project are same as in Hypothesis 1. Sewer connection rates in the present sewered areas will rise.

Hypothesis 3 Per-capita water consumption and sewer connection rates in the present sewered areas will rise, but no sewerage project will be implemented. This hypothesis envisages that demands for water supply will be satisfied by the completion of Cayor Canal.

Hypothesis 4 Per-capita water consumption remains the same as at present. Connection rates will rise. Major sewerage projects will be realized.

Hypothesis 5 Same as Hypothesis 4 except that per-capita water consumption will rise.

Population served by the sewerage system, water consumption and sewage flow collected in each hypothesis are as follows:

| Hypothesis | 1989 Present | 2010 1 | 2 |
|---|---|---|---|
| Population | 1,296,010 | 2,555,466 *1 | |
| Population served | 416,646 | 722,475 | 785,061 |
| Water consumption ($m^3$/day) | 105,823 | 168,361 | 179,751 |
| Sewage flow ($m^3$/day) | 84,383 | 135,664 | 145,331 |

| Hypothesis | 3 | 4 | 5 |
|---|---|---|---|
| Population | | 2,555,466 *1 | |
| Population served | 785,061 | 1,090,038 | 1,090,038 |
| Water consumption ($m^3$/day) | 229,955 | 209,150 | 267,643 |
| Sewage flow ($m^3$/day) | 186,399 | 169,891 | 217,657 |

Note:Additional population of 262,682 was projected for an unidentified area. Total population in the Study Area in 2010 is 2,815,459.

The proposed scenario corresponds to Hypothesis 5, and the same hypothesis is to be considered as the base for the current study.

3) SONEES Proposals Since 1991

Three proposals regarding improvement of the existing sewerage system have been prepared by SONEES. Documents available regarding these three proposals are 1) Report on the Installation Project of Cite Faycal, January 1991 (PROJECT DE RACCORDEMENT DE LA CITE FAYCAL, MEMOIRE DESCRIPTIF), 2) Tender Documents for Sewage and Stormwater Sanitation at Low Point in HLM Las Palmas of Guedidawaye, September 1992 (ASSAINISSEMENT DU POINT BAS DES HLM LAS PALMAS DE GUEDIAWAYE EAUX USEES ET EAUX PLUVIALS, DOCUMENTS D'APPEL D'OFFRES), and 3) Memorandum on the Function of the Sewerage System in Parcelles Assainies, May 1993 (MEMORANDAUM SUR LE FONCTIONNEMENT DU SYSTEME D'ASSAINISSEMENT DES PARCELLES ASSAINIES). A brief description of these documents is given below.

(1) Report on the Installation Project of City Faycal

City Faycal is an area where 53 villa style large detached houses and some communal facilities are located. The area is provided with a complete separate sewerage system. Wastewaters are collected by sewers and sent to a mini treatment plant which was constructed by the developer. The mini plant has never been used because of technical problems. Wastewater is being discharged to the nearby Niaye area without any treatment.

A project was proposed to construct a submersible pumping station at the place of the mini plant and a force main to convey wastewater to the Camberene WWTP. Drawings, technical specifications and cost estimates have been prepared by SONEES. Total construction cost was estimated to be approximately 34.5 million F CFA. The project is expected to commence shortly.

(2) Tender Documents for Sewage and Stormwater Sanitation at Low Point in HLM Las Palmas of Guediawaye

At present, when it rains a low point in HLM Las Palmas is flooded with stormwater runoff. Inundated water is collected by roadside open channels, and flows into Guediawaye pumping station. The pumping station was constructed to send wastewater from the HLM Las Palmas to the Niaye WWTP, but recently the destination has been changed to Camberene WWTP. Thus the storm water is pumped to Camberene WWTP together with wastewater resulting in an unexpected increase in the inflow to the plant.

In order to avoid adverse effects caused by stormwater to the proper operation of the plant, and to increase wastewater flow to Camberene WWTP by improving pumping capacity of the existing P/S No.2 in Parcelles Assainies, SONEES planned an improvement project. Design work and preparation of the tender documents were carried out by SONEES.

The project consists of two parts, viz. Part 1 stormwater drainage, and Part 2 wastewater. Several work components are included in each part. Part 1 includes improvement of the open drains with steel grids and construction of a retention pond. Collected stormwater is to be pumped by the existing pumping station to Niaye. The existing pumping station will exclusively be used for storm water drainage.

Part two includes construction of a new pumping station which should be used for wastewater and improvement of force mains which connect the existing P/S No.2 in Parcelles Assainies to the new pumping station. Wastewater collected to the new pumping station will be sent to Camberene WWTP.

Tendering has yet to take place for this project.

(3) Memorandum on the Function of the Sewerage System in Parcelles Assainies

Pumping stations in Parcelles Assainies often cause wastewater flooding problems. In order to mitigate the situation, SONEES intended to modify the existing sewer networks including pumping stations. The project consists of the following three components.

i) Disconnection of the force main from the existing pumping station HLM Grand-Medina (P/S 23) to P/S 15, and installation of a new force main to the existing gravity sewer. Construction cost is 30 million F CFA.

ii) Double the present capacity of P/S 15. Construction cost is50 million F CFA.

iii) Installation of automatic screening at P/S 13. Construction cost is 15 million F CFA.

The early implementation of the project is expected. Nevertheless, the present status is not known.

## 1.3 ON-SITE SYSTEM

### 1.3.1 General

As mentioned in the previous section, disposal of wastewater generated in the area not covered by a sewerage system rely on an individual sanitation system called "on-site system". Even in the area covered by sewerage system (shown in *Figure* B.1.1), there are many houses that rely on the on-site system because the houses in such area are not always connected to the public sewers.

A table below gives population by several wastewater disposal types. Among a total population of 1.5 million, 870 thousand are living in the area not covered by sewerage service and, in addition, 200 thousand people in the area covered by sewerage are not connected to sewers. Thus, about one million people, 67 % of the total, rely on the on-site system for their wastewater disposal. It can be said that the on-site system is presently major facilities of wastewater disposal in the study area.

***Population by Wastewater Disposal Types***

| Area | Connection | | Total |
|---|---|---|---|
| | Connected to sewers | Not connected to sewers | |
| Covered by sewerage system | 453,960 | 192,089 | 646,049 |
| Not covered by sewerage system | 0 | 871,351 | 871,351 |
| Total | 453,960 | 1,063,440 | 1,517,400 |

### 1.3.2 Types of On-site System

The existing on-site system used in the Study area can be classified into three major types shown in *Figure* B.1.13. However, it should be noted that there are some people who have no toilet facilities in their house. Features of each type are as follows:

1) Simple toilet

In this type, there is no flush water and excreta is directly discharge to a pit under a toilet stool, where excreta is accumulated. Usually no sludge water is mixed. All wastewater other than toilet waste is poured onto the ground or into a sludge pit. For the final disposal, there are two methods; infiltration into the ground (for this purpose, some have a soakaway) and a periodical withdrawing of the accumulated excreta.

2) Turkish toilet without septic tank

Excreta is transferred by a small amount of water, usually supplied by a can, from a stool to a pit. Overflow from a pit is normally introduced to a soakaway to be penetrated into the ground, but a soakaway is not provided in some cases and excreta is penetrated directly from the pit. Wastewater other than toilet waste is poured either into the soakaway, into an infiltration pit, or onto the ground.

3) Turkish toilet with septic tank

Excreta is transferred by a small amount of water from stool to a septic tank. Supernatant of the septic tank flows into soakaway. Wastewater other than toilet waste sometimes is collected in the septic tank and in other cases is poured into the infiltration pit.

### 1.3.3 Present On-site System in the Study Area

*Table* B.1.18 shows methods of wastewater disposal by the housing types. Typical on-site system in each housing type is summarized as below, based on the data in the table:

1) Type 1 (Village)

In this type, about 76% of the toilet are of the Turkish toilet without septic tank. Wastewater other than from toilet is discharged to the ground, the street or the penetration pit.

2) Type 2 (Spontaneous, Irregular)

More than 95% of the toilet are of the Turkish toilet without septic tank. Wastewater other than from toilet is discharged to the ground, the street or the penetration pit.

3) Type 3 (Spontaneous, Regular)

45% of this type are covered by a sewerage system. Thus, 16 % of the toilet are of flush type toilet that flushes out the excreta by pressured water. Major type of the toilet is still Turkish toilet mainly without septic tank. Wastewater other than from toilet is discharged to the ground, the street or the penetration pit in case of no sewerage system.

4) Type 4 (Planned)

About 70% of this type are covered by a sewerage system and 36% of the toilets are of the flush type. In case of no sewerage system, the Turkish toilet is a dominant type. Wastewater other than from toilet is discharged to the septic tank or the penetration pit in case of no sewerage system.

5) Type 5 (Detached)

Most of this type (73%) are covered by a sewerage system. On-site system in this type relies on the Turkish toilet with or without septic tank. Wastewater other than from toilet is discharged to the septic tank or the penetration pit in case of no sewerage system.

6) Type 6 (Flats)

This type is covered by a sewerage system. There is no on-site system in this type.

### 1.3.4 Operation of On-site Treatment

As mentioned above, toilet waste (excreta) disposal relies on the Turkish toilet with or without septic tank and wastewater other than toilet waste is discharged to the ground, road, penetration pit or septic tank in most of the on-site system in the study area.

In the Turkish toilet with soakaway, it is considered that the penetration has been intentionally adopted as a method of the final disposal. The Turkish toilet without a soakaway is considered to require periodical withdrawal of the accumulated excreta. However, it is considered that seepage from pits or tanks is penetrated into the ground because structures of such pits or tanks are not water proofed. This would be evident from the following facts mentioned in the Strategy Plan:

- 45 % of the Turkish toilet have never had a withdrawal of the excreta.
- 45% of the Turkish toilet have the withdrawal once a year.
- 7% of the Turkish toilet have the withdrawal once per two months.
- 2% of the Turkish toilet have the withdrawal once a month.

Therefore, in the present on-site system, all wastewater is finally penetrated into the ground though there are several routes such as with or without septic tank, and being discharged to pits, on to the ground or roads.

# TABLE B.1.1 (1) PRESENT SEWERED AREA AND POPULATION (1993)

(1/3)

| No. | Unit Name | Area(ha) | H. Type | Population | Conn.Ratio(%) | Sewered Pop. |
|---|---|---|---|---|---|---|
| 75 | Plateau | 388.8 | 6 | 54,321 | 68 | 36,938 |
| 75 b | Hopitaux (PP et Dantec) | 13.6 | | 0 | 100 | 0 |
| | sub-total | 402.4 | 6 | 54,321 | 68 | 36,938 |
| 46 | Equipements (CTO-CAEDA) | 12.0 | | 0 | 100 | 0 |
| 46 b | Zone de Captage | 24.4 | | 0 | 0 | 0 |
| 47 | Gendarmerie Front de Terre | 16.4 | | 0 | 100 | 0 |
| 48 | Cite Front de Terre Milli. | 6.4 | | 1,226 | 100 | 1,226 |
| 49 | Equipements Sportifs | 4.0 | | 0 | 0 | 0 |
| 50 | SODIDA & Zone Artisanale | 47.2 | | 0 | 100 | 0 |
| 50 b | Zone Industrielle | 21.2 | | 0 | 100 | 0 |
| 52 | SICAP | 435.6 | 4 | 125,888 | 100 | 125,888 |
| 24 | Cite SOTRAC-Mermoz | 12.0 | 5 | 1,439 | 100 | 1,439 |
| 25 | Fenetre Mermoz | 14.4 | 5 | 2,096 | 100 | 2,096 |
| 26 | Services Tech. SOTRAC | 18.4 | | 0 | 100 | 0 |
| 27 | Equipements Scolaires | 13.6 | | 0 | 100 | 0 |
| 28 | Mermoz-Fann | 20.0 | 5 | 3,180 | 100 | 3,180 |
| 29 | Terrain Militaire | 17.6 | | 0 | 0 | 0 |
| 30 | Zone Equipements | 7.2 | | 0 | 100 | 0 |
| 51 | H.L.M. Nimzatt | 89.2 | 4 | 37,379 | 95 | 35,510 |
| 51 b | Cite Douanes | 12.0 | 4 | 2,545 | 100 | 2,545 |
| 52 b | Grand Dakar | 76.0 | 3 | 25,536 | 61 | 15,577 |
| 52 t | Grand Dakar Usine | 40.0 | 3 | 13,440 | 61 | 8,198 |
| 53 | Zone Equip. Cerf Volant | 69.2 | | 0 | 100 | 0 |
| 53 b | Ouagou Niaye | 20.8 | 4 | 6,146 | 80 | 4,917 |
| 53 t | BOPP | 13.6 | 4 | 3,930 | 100 | 3,930 |
| 54 | H.L.M. Fass Ancien | 3.6 | 4 | 1,509 | 100 | 1,509 |
| 55 | Fass | 14.6 | 3 | 4,633 | 70 | 3,243 |
| 55 b | Zone A et B | 20.0 | 4 | 5,537 | 100 | 5,537 |
| 56 | H.L.M. Fass Paillotes | 7.6 | 4 | 2,104 | 100 | 2,104 |
| 57 | Fass Delorme | 34.8 | 4 | 10,057 | 70 | 7,040 |
| 58 | Marche de Fass | 4.0 | | 0 | 0 | 0 |
| 59 | Point E | 76.0 | 5 | 9,294 | 100 | 9,294 |
| 59 b | Lycee | 1.6 | | 0 | 100 | 0 |
| 60 | Ecole de Police | 9.6 | | 0 | 100 | 0 |
| 61 | SICAP Mermoz | 26.4 | 4 | 7,630 | 100 | 7,630 |
| 62 | Fann Residence | 96.4 | 5 | 7,124 | 100 | 7,124 |
| 63 | Universite, Ecoles | 123.6 | | 0 | 100 | 0 |
| 63 b | Cent. Hospit. Univ. Fann | 26.0 | | 0 | 100 | 0 |
| 64 | Cimetiere Soumbedioune | 19.2 | | 0 | 0 | 0 |
| 65 | SICAP Fann Hock | 30.0 | 4 | 8,549 | 100 | 8,549 |
| 66 | Gueule Tapee | 38.0 | 4 | 12,768 | 87 | 11,108 |
| 67 | Medina | 160.8 | 3 | 53,639 | 83 | 44,520 |
| 68 | H.L.M. Centenaire | 30.8 | 4 | 8,901 | 100 | 8,901 |
| 69 | Gendarmerie Colobane | 16.0 | | 0 | 100 | 0 |
| 70 | Colobane | 33.2 | 4 | 9,192 | 37 | 3,401 |
| 71 | Marche Colobane | 1.4 | | 0 | 0 | 0 |
| 71 b | Gare Routiere Colobane | 1.2 | | 0 | 0 | 0 |
| 72 | Equip. Admin. Triangle Sud | 26.8 | | 0 | 0 | 0 |
| 73 | Equipements (stade) | 6.8 | | 0 | 100 | 0 |
| 74 | Ex Camp Lat Dior | 12.0 | | 0 | 0 | 0 |
| 76 | Reubeuss | 21.2 | 3 | 7,089 | 81 | 5,742 |
| 77 | Equipements (gare routiere) | 11.2 | | 0 | 100 | 0 |
| 78 | Camp Abdou Diasse | 6.0 | | 0 | 100 | 0 |
| | sub-total | 1850.0 | | 370,831 | 89 | 330,208 |
| 153 | Zone Franche Industrie | 60.4 | | 0 | 0 | 0 |
| 79 | Port Autonome de Dakar | 414.0 | | 0 | 100 | 0 |
| 80 | Zone Industrielle | 450.0 | | 0 | 80 | 0 |
| 81 | Hann Village | 16.0 | 1 | 8,939 | 0 | 0 |
| 92 | Castors Municipaux Cite | 13.6 | 4 | 4,012 | 0 | 0 |
| 93 | Hann Pecheurs | 46.0 | 1 | 22,969 | 0 | 0 |
| 115 | Equipements (abattoirs) | 10.8 | | 0 | 0 | 0 |
| 115 b | Manche Poisson | 2.0 | | 0 | 100 | 0 |
| 116 | Petite Fabrique | 0.8 | | 0 | 0 | 0 |
| 117 | Parc a Materiaux Artisans | 8.0 | | 0 | 0 | 0 |
| 118 | Usine SIPS | 4.8 | | 0 | 0 | 0 |
| 122 | Village Thiaroye/Mer | 72.8 | 1 | 21,639 | 0 | 0 |
| 123 | Cite Thiaroye | 33.2 | 5 | 7,124 | 0 | 0 |
| | sub-total | 1132.4 | | 64,683 | 0 | 0 |

# TABLE B.1.1 (2) PRESENT SEWERED AREA AND POPULATION (1993)

(2/3)

| No. | Unit Name | Area(ha) | H. Type | Population | Conn,Ratio(%) | Sewered Pop. |
|---|---|---|---|---|---|---|
| 31 | Camp Militaire/Camp Penal | 90.0 | | 0 | 100 | 0 |
| 32 | Foire Internationale | 38.4 | | 0 | 0 | 0 |
| 33 | Village des Arts | 2.4 | | 0 | 0 | 0 |
| 34 | Cite BCEAO | 3.6 | 5 | 639 | 100 | 639 |
| 35 | Cite Foire Nord | 16.4 | 4 | 3,342 | 100 | 3,342 |
| 36 | Cite Adama Diop | 2.0 | 5 | 370 | 100 | 370 |
| 37 | Lotissement Djily Mbaye | 34.4 | 5 | 1,284 | 100 | 1,284 |
| 38 | Cite Diamalaye | 15.2 | 4 | 9,007 | 0 | 0 |
| 39 | Cimetiere | 31.6 | | 0 | 0 | 0 |
| 39 b | Cite BCEAO (cadres) | 6.4 | 5 | 239 | 100 | 239 |
| 40 | H.L.M. Grand Medine | 5.2 | 4 | 1,830 | 90 | 1,647 |
| 41 | Stade Amitie | 15.6 | | 0 | 100 | 0 |
| 42 | Grand Medine | 26.0 | 2 | 16,130 | 0 | 0 |
| 43 | H.L.M. Grand Yoff/Khar Yalla | 9.6 | 4 | 4,750 | 100 | 4,750 |
| 43 b | SCAT-URBAM | 186.4 | 4 | 13,882 | 0 | 0 |
| 44 | H.L.M. Patte d'Oie | 13.6 | 4 | 6,648 | 100 | 6,648 |
| 45 | Grand Yoff/Khar Yalla | 126.0 | 3 | 42,138 | 5 | 2,107 |
| 82 | Equipements (CEREEG) | 12.0 | | 0 | 0 | 0 |
| 83 | Habitat Grand Standing | 9.2 | 5 | 1,237 | 0 | 0 |
| 84 | Prison Fort B | 9.2 | | 0 | 0 | 0 |
| 85 | Parc Zoologique, ISRA | 87.2 | | 0 | 0 | 0 |
| 86 | Cite Ady Niang | 14.8 | 5 | 1,587 | 0 | 0 |
| 87 | Equip. SENELEC Ecole | 12.8 | | 0 | 0 | 0 |
| 88 | Petite Cite | 2.0 | 5 | 95 | 0 | 0 |
| 89 | SICAP 2 | 221.2 | 4 | 0 | 0 | 0 |
| 98 | Cite Builders | 24.0 | 4 | 6,936 | 100 | 6,936 |
| 99 | Lotis. Impots et Domaine | 18.4 | 4 | 3,461 | 100 | 3,461 |
| 100 | SOPRIM | 7.6 | 4 | 2,412 | 100 | 2,412 |
| 101 | Parcelles Assainies | 386.8 | 3 | 123,905 | 25 | 30,976 |
| 90 | Dalifort | 18.0 | 2 | 7,779 | 0 | 0 |
| 91 | HACIENDA | 4.0 | 5 | 567 | 0 | 0 |
| 94 | Cite Faycal | 7.2 | 5 | 404 | 100 | 404 |
| 94 b | TECHNOPOLE | 80.0 | | 0 | 0 | 0 |
| 95 | St. de Epuration Camberene | 19.2 | | 0 | 0 | 0 |
| 96 | Ecole d'Horticulture | 4.4 | | 0 | 0 | 0 |
| 97 | Direction Espaces Verts | 52.0 | | 0 | 0 | 0 |
| 103 | Lotissements en Cours | 10.0 | 4 | 543 | 0 | 0 |
| 104 | Lotissements en Cours | 20.8 | 4 | 1,129 | 0 | 0 |
| 104 b | CADMI | 0.0 | | 0 | 0 | 0 |
| 104 t | Marche aux Poissons | 0.0 | | 0 | 0 | 0 |
| 105 | HAMO | 8.0 | 4 | 4,521 | 0 | 0 |
| 111 | Pikine Regulier | 328.8 | 3 | 85,300 | 0 | 0 |
| 112 | Cite Lobatt Fall | 4.0 | 4 | 757 | 0 | 0 |
| 113 | Gare Routiere | 1.3 | | 0 | 0 | 0 |
| 114 | Cite ICOTAF | 0.2 | 5 | 49 | 100 | 49 |
| 119 | Guinaw Rail | 110.8 | 2 | 47,887 | 0 | 0 |
| 120 | Equip. SOTRAC, OPCE, SO | 17.6 | | 0 | 0 | 0 |
| 128 | Pikine Irregulire, Thiaroye | 294.4 | 2 | 98,708 | 0 | 0 |
| | sub-total | 2408.7 | | 487,536 | 13 | 65,264 |
| 9 | Cite ASECNA | 6.0 | 4 | 1,509 | 100 | 1,509 |
| 10 | Cite Assemblee | 15.6 | 4 | 3,922 | 100 | 3,922 |
| 11 | Cite ASECNA (habitat eco.) | 7.6 | 4 | 1,911 | 100 | 1,911 |
| 12 | Equipements | 2.8 | | 0 | 0 | 0 |
| 13 | Equipements (elavage) | 6.0 | | 0 | 100 | 0 |
| 14 | Cite ASECNA (cadres) | 8.0 | 5 | 869 | 100 | 869 |
| 15 | Terrain de Sports | 25.2 | | 0 | 0 | 0 |
| 16 | Zone mil. Camp ARCHIN | 48.0 | | 0 | 100 | 0 |
| 17 | Village de Ouakam | 75.2 | 1 | 22,223 | 0 | 0 |
| 18 | Base Aerienne Terme Sud | 58.4 | | 0 | 100 | 0 |
| 19 | Cite des Douanes | 50.0 | 4 | 8,805 | 0 | 0 |
| 20 | Quartir Touba Ouakam | 42.0 | 2 | 10,674 | 0 | 0 |
| 21 | Ter. Mil. Ecole Gendarmerie | 108.0 | | 0 | 100 | 0 |
| 22 | Equipements | 0.8 | | 0 | 0 | 0 |
| 23 | Cite Africa | 14.4 | 5 | 1,528 | 100 | 1,528 |
| | sub-total | 468.0 | | 51,441 | 19 | 9,739 |

# TABLE B.1.1 (3) PRESENT SEWERED AREA AND POPULATION (1993)

(3/3)

| No. | Unit Name | Area(ha) | H. Type | Population | Conn,Ratio(%) | Sewered Pop. |
|---|---|---|---|---|---|---|
| 106 | Equipement Militaire | 3.2 | | 0 | 0 | 0 |
| 107 | Lotissement Golf Nord | 6.0 | 5 | 418 | 100 | 418 |
| 108 | Terrain de Golf | 25.2 | | 0 | 0 | 0 |
| 108 b | Cite Golf Sud | 36.0 | 3 | 12,525 | 0 | 0 |
| 109 | Cite Adama Diop HAMO | 16.0 | 4 | 4,581 | 0 | 0 |
| 109 b | H.L.M. Guediawaye | 22.0 | 4 | 9,416 | 90 | 8,474 |
| 110 | Niayes | 880.8 | | 0 | 0 | 0 |
| 112 b | Cite SOTIBA | 10.0 | 4 | 2,917 | 100 | 2,917 |
| 129 | Pikine Guediawaye | 515.2 | 3 | 131,572 | 0 | 0 |
| 130 | Cite HAMO | 4.4 | 4 | 1,760 | 0 | 0 |
| 130 b | Cite Adama Diop/Barry | 3.6 | 4 | 1,440 | 0 | 0 |
| 131 | Golf Guediawaye | 24.8 | 3 | 4,558 | 0 | 0 |
| 132 | Lotissement | 10.4 | 4 | 705 | 0 | 0 |
| 133 | Lotissement en Cours | 7.2 | 4 | 488 | 0 | 0 |
| 134 | Lotissment | 11.6 | 4 | 787 | 0 | 0 |
| | sub-total | 1576.4 | | 171,167 | 7 | 11,809 |
| 121 | Camp Militaire Faidherbe | 81.6 | | 0 | 0 | 0 |
| 121 b | Redevelopment of 121, 81.6 ha | 0.0 | | 0 | 0 | 0 |
| 124 | Cite Tivaoune | 23.3 | 2 | 10,070 | 0 | 0 |
| 125 | Diaksao 1 | 38.0 | 2 | 16,423 | 0 | 0 |
| 126 | Diaksao 2 | 60.0 | 2 | 25,931 | 0 | 0 |
| 127 | Lotissement Rochette | 12.0 | 3 | 1,031 | 0 | 0 |
| 135 | Centre Transmission As | 34.0 | | 0 | 0 | 0 |
| 136 | Centre Transmission Ar | 104.0 | | 0 | 0 | 0 |
| 137 | Village de Malika | 70.0 | 1 | 18,160 | 0 | 0 |
| 138 | Extension Village de Malika | 35.6 | 1 | 9,810 | 0 | 0 |
| 139 | Centre Emetteur SONATEL | 60.8 | | 0 | 0 | 0 |
| 140 | Village de Keur Massar | 30.0 | 1 | 2,891 | 0 | 0 |
| 141 | Village Keur Abdou | 14.0 | 1 | 2,630 | 0 | 0 |
| 142 | Centre Evangelique | 4.0 | | 0 | 0 | 0 |
| 142 b | Parcelles Assainies de Malika | 418.0 | 4 | 0 | 0 | 0 |
| 143 | Village de Yeumbeul | 518.8 | 1 | 82,736 | 0 | 0 |
| 144 | Village de Boune | 16.4 | 1 | 3,081 | 0 | 0 |
| 145 | SICAP Mbao | 30.0 | 4 | 2,843 | 0 | 0 |
| 146 | Foirail | 4.0 | | 0 | 0 | 0 |
| 147 | Fass Mbao | 34.8 | 3 | 4,368 | 0 | 0 |
| 148 | Diamaguene. | 135.2 | 2 | 42,266 | 0 | 0 |
| 149 | Cite SABE | 2.0 | 5 | 443 | 0 | 0 |
| 150 | LGI (Gendarmerie) | 52.2 | | 0 | 0 | 0 |
| 151 | Centre Institut Pasteur | 40.0 | | 0 | 0 | 0 |
| 152 | Cite Gueye | 3.6 | 4 | 789 | 0 | 0 |
| 154 | Village Mbao Goundao | 12.8 | 1 | 2,821 | 0 | 0 |
| 155 | Village Grand Mbao | 20.8 | 1 | 6,322 | 0 | 0 |
| 156 | Centre National d'Aviculture | 22.0 | | 0 | | 0 |
| 157 | Village de Kamb Goundao | 20.8 | 1 | 3,907 | 0 | 0 |
| 158 | Foret Classee de Mbao | 0.0 | | 0 | | 0 |
| | sub-total | 1898.7 | | 236,522 | 0 | 0 |
| 1 | Equip. Tourist. Almadies | 30.1 | | 0 | 0 | 0 |
| 2 | OCI | 40.8 | | 0 | 0 | 0 |
| 3 | Remembrement Almadies | 100.0 | 5 | 5,757 | 0 | 0 |
| 4 | Village de Ngor | 22.0 | 1 | 7,400 | 0 | 0 |
| 5 | Zone Touristique Ngor | 39.6 | | 0 | 0 | 0 |
| 6 | Habitat Grand Standing Ngor | 5.2 | 5 | 313 | 0 | 0 |
| 7 | Ranrhar | 66.0 | 5 | 7,807 | 0 | 0 |
| 7 b | Village de Yoff | 125.2 | 1 | 36,015 | 0 | 0 |
| 8 | Aeroport | 1174.8 | | 0 | 0 | 0 |
| 102 | Village de Camberene | 64.4 | 1 | 23,607 | 0 | 0 |
| | sub-total | 1668.1 | | 80,899 | 0 | 0 |
| 159 | Zone Speciale de Mbao Gare | 647.0 | 4 | 0 | 0 | 0 |
| | Grand Total | 12051.7 | | 1,517,400 | 30 | 453,958 |

Source : StrategyPlan modified by Study Team

## TABLE B.1.2 PUMPING STATIONS (SEWERAGE)

| No. | Name | Location | Type | Capacity (l/s) | Total Head(m) |
|---|---|---|---|---|---|
| 1 | MERMOZ | Mermoz | S | 16 | 17 |
| 2 | UNIVERSITE | Universite | D | 230 | 12 |
| 3 | SOUMBEDIOUNE | Baie Soumbedioune | D | 125 | 14 |
| 4 | MALICK SY | Angle Malick Sy | S | 78 | 3 |
| 5 | RUE 10 | Rue 10 | S | 73 | 4 |
| 6 | NIMZATT | Mimzatt | S | 42 | 13 |
| 7 | OUAGOUNIAYES | Ouagouniayes | S | 36 | 13 |
| 8 | ZONE INDUSTRIE | Zone Industrie | S | 64 | 4 |
| 9 | III B (GENIE RURAL) | Hann | S | 34 | 12 |
| 10 | FAYCAL | Cite Faycal | S | 14 | |
| 11 | UNITE 9 | Parcell Assainies | S | 15 | 18 |
| 12 | UNITE 15 | Parcell Assainies | S | 20 | 22 |
| 13 | UNITE 23 | Parcell Assainies | S | 12 | 16 |
| 14 | UNITE 17 | Parcell Assainies | S | 5 | 5 |
| 15 | UNITE 22 | Parcell Assainies | S | 21 | 6 |
| 16 | UNITE 7 | Parcell Assainies | S | 24 | 15 |
| 17 | UNITE 13 | Parcell Assainies | S | 53 | 18 |
| 18 | DJILY MBAYE | Parcell Assainies | S | 35 | 17 |
| 19 | UNITE 2 | Parcell Assainies | S | 29 | 19 |
| 20 | GUEDIAWAYE | Guediawaye | S | 16 | 17 |
| 21 | XII (DOMINIQUE) | Pikine Centre | S | 35 | 7 |
| 22 | CIMETIARA | Pikine SR12 | S | 120 | 30 |
| 23 | SOTIBA | Sotiba | S | 13 | 15 |
| 24 | MARCHE AUX POISSONS | Marche aux Poissins | S | 17 | |
| 25 | SACRE COLUR III | | | | |

Note : Type S : Submersible
Type D : Dry Pit

Source : SONEES

# TABLE B.1.3 (1) PRESENT WASTEWATER FLOW (PRODUCTION AND COLLECTED BY SEWERAGE) (1993)

(1/3)

| No. | Unit Name | Pop. | Conn.R.(%) | Pop.Eq. | (lpcd) | Domestic | Industrial | Dis.R.(%) | Flow |
|---|---|---|---|---|---|---|---|---|---|
| 75 | Plateau | 54,321 | 68 | 0 | 314 | 17,057 | 0 | 85 | 9,859 |
| 75 b | Hopitaux (PP et Dantec) | 0 | 100 | 4,300 | 150 | 645 | 0 | 80 | 516 |
| | sub-total | 54,321 | 68 | 4,300 | 302 | 17,702 | 0 | | 10,375 |
| 46 | Equipements (CTO-CAEDA) | 0 | 100 | 500 | 150 | 75 | 0 | 75 | 56 |
| 46 b | Zone de Captage | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 47 | Gendarmerie Front de Terre | 0 | 100 | 200 | 150 | 30 | 0 | 75 | 23 |
| 48 | Cite Front de Terre Milli. | 1,226 | 100 | 0 | 199 | 244 | 0 | 75 | 183 |
| 49 | Equipements Sportifs | 0 | 0 | 25 | 150 | 4 | 0 | 80 | 0 |
| 50 | SODIDA & Zone Artisanale | 0 | 100 | 3,000 | 150 | 450 | 0 | 80 | 360 |
| 50 b | Zone Industrielle | 0 | 100 | 1,350 | 150 | 203 | 0 | 80 | 162 |
| 52 | SICAP | 125,888 | 100 | 0 | 148 | 18,631 | 0 | 80 | 14,905 |
| 24 | Cite SOTRAC-Mermoz | 1,439 | 100 | 0 | 236 | 340 | 0 | 75 | 255 |
| 25 | Fenetre Mermoz | 2,096 | 100 | 0 | 236 | 495 | 0 | 75 | 371 |
| 26 | Services Tech. SOTRAC | 0 | 100 | 470 | 150 | 71 | 0 | 75 | 53 |
| 27 | Equipements Scolaires | 0 | 100 | 0 | | 0 | 0 | 75 | 0 |
| 28 | Mermoz-Fann | 3,180 | 100 | 0 | 236 | 750 | 0 | 75 | 563 |
| 29 | Terrain Militaire | 0 | 0 | 0 | | 0 | 0 | 75 | 0 |
| 30 | Zone Equipements | 0 | 100 | 0 | | 0 | 0 | 80 | 0 |
| 51 | H.L.M. Nimzatt | 37,379 | 95 | 0 | 172 | 6,429 | 0 | 80 | 4,886 |
| 51 b | Cite Douanes | 2,545 | 100 | 0 | 172 | 438 | 0 | 80 | 350 |
| 52 b | Grand Dakar | 25,536 | 61 | 0 | 63 | 1,609 | 0 | 85 | 834 |
| 52 t | Grand Dakar Usine | 13,440 | 61 | 0 | 63 | 847 | 0 | 85 | 439 |
| 53 | Zone Equip. Cerf Volant | 0 | 100 | 0 | | 0 | 0 | 80 | 0 |
| 53 b | Ouagou Niaye | 6,146 | 80 | 0 | 100 | 615 | 0 | 80 | 394 |
| 53 t | BOPP | 3,930 | 100 | 0 | 100 | 393 | 0 | 80 | 314 |
| 54 | H.L.M. Fass Ancien | 1,509 | 100 | 0 | 157 | 237 | 0 | 80 | 190 |
| 55 | Fass | 4,633 | 70 | 0 | 100 | 463 | 0 | 85 | 275 |
| 55 b | Zone A et B | 5,537 | 100 | 0 | 157 | 869 | 0 | 80 | 695 |
| 56 | H.L.M. Fass Paillotes | 2,104 | 100 | 0 | 157 | 330 | 0 | 80 | 264 |
| 57 | Fass Delorme | 10,057 | 70 | 0 | 100 | 1,006 | 0 | 80 | 563 |
| 58 | Marche de Fass | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 59 | Point E | 9,294 | 100 | 0 | 159 | 1,478 | 0 | 85 | 1,256 |
| 59 b | Lycee | 0 | 100 | 100 | 150 | 15 | 0 | 75 | 11 |
| 60 | Ecole de Police | 0 | 100 | 530 | 150 | 80 | 0 | 80 | 64 |
| 61 | SICAP Mermoz | 7,630 | 100 | 0 | 148 | 1,129 | 0 | 80 | 903 |
| 62 | Fann Residence | 7,124 | 100 | 0 | 159 | 1,133 | 0 | 85 | 963 |
| 63 | Universite, Ecoles | 0 | 100 | 10,000 | 150 | 1,500 | 0 | 80 | 1,200 |
| 63 b | Cent. Hospit. Univ. Fann | 0 | 100 | 8,400 | 150 | 1,260 | 0 | 70 | 882 |
| 64 | Cimetiere Soumbedioune | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 65 | SICAP Fann Hock | 8,549 | 100 | 0 | 157 | 1,342 | 0 | 80 | 1,074 |
| 66 | Gueule Tapee | 12,768 | 87 | 0 | 100 | 1,277 | 0 | 85 | 944 |
| 67 | Medina | 53,639 | 83 | 0 | 100 | 5,364 | 0 | 85 | 3,784 |
| 68 | H.L.M. Centenaire | 8,901 | 100 | 0 | 157 | 1,397 | 0 | 80 | 1,118 |
| 69 | Gendarmerie Colobane | 0 | 100 | 900 | 150 | 135 | 0 | 75 | 101 |
| 70 | Colobane | 9,192 | 37 | 0 | 100 | 919 | 0 | 85 | 289 |
| 71 | Marche Colobane | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 71 b | Gare Routiere Colobane | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 72 | Equip. Admin. Triangle Sud | 0 | 0 | 100 | 150 | 15 | 0 | 80 | 0 |
| 73 | Equipements (stade) | 0 | 100 | 0 | | 0 | 0 | 80 | 0 |
| 74 | Ex Camp Lat Dior | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 76 | Reubeuss | 7,089 | 81 | 0 | 128 | 907 | 0 | 85 | 624 |
| 77 | Equipements (gare routiere) | 0 | 100 | 0 | | 0 | 0 | 80 | 0 |
| 78 | Camp Abdou Diasse | 0 | 100 | 0 | | 0 | 0 | 75 | 0 |
| | sub-total | 370,831 | 89 | 25,575 | 132 | 52,480 | 0 | | 39,348 |
| 153 | Zone Franche Industrie | 0 | 0 | | | 0 | 2,174 | 80 | 0 |
| 79 | Port Autonome de Dakar | 0 | 100 | 20,400 | 150 | 3,060 | 1,188 | 80 | 3,398 |
| 80 | Zone Industrielle | 0 | 80 | 5,500 | 150 | 825 | 7,488 | 80 | 5,320 |
| 81 | Hann Village | 8,939 | 0 | 0 | 72 | 644 | | 85 | 0 |
| 92 | Castors Municipaux Cite | 4,012 | 0 | 0 | 151 | 606 | 0 | 80 | 0 |
| 93 | Hann Pecheurs | 22,969 | 0 | 0 | 75 | 1,723 | 0 | 85 | 0 |
| 115 | Equipements (abattoirs) | 0 | 0 | 100 | 150 | 15 | 180 | 80 | 0 |
| 115 b | Manche Poisson | 0 | 100 | 100 | 150 | 15 | 180 | 80 | 156 |
| 116 | Petite Fabrique | 0 | 0 | 0 | | 0 | 29 | 80 | 0 |
| 117 | Parc a Materiaux Artisans | 0 | 0 | 0 | | 0 | 288 | 80 | 0 |
| 118 | Usine SIPS | 0 | 0 | 0 | | 0 | 173 | 80 | 0 |
| 122 | Village Thiaroye/Mer | 21,639 | 0 | 0 | 65 | 1,407 | 0 | 85 | 0 |
| 123 | Cite Thiaroye | 7,124 | 0 | 0 | 241 | 1,717 | 0 | 75 | 0 |
| | sub-total | 64,683 | 0 | 26,100 | 110 | 10,012 | 11,700 | | 8,874 |

# TABLE B.1.3 (2) PRESENT WASTEWATER FLOW (PRODUCTION AND COLLECTED BY SEWERAGE) (1993)

(2/3)

| No. | Unit Name | Pop. | Conn.R.(%) | Pop.Eq. | (lpcd) | Domestic | Industrial | Dis.R.(%) | Flow |
|---|---|---|---|---|---|---|---|---|---|
| 31 | Camp Militaire/Camp Penal | 0 | 100 | 1,000 | 150 | 150 | 0 | 75 | 113 |
| 32 | Foire Internationale | 0 | 0 | 25 | 150 | 4 | 0 | 75 | 0 |
| 33 | Village des Arts | 0 | 0 | 10 | 150 | 2 | 0 | 80 | 0 |
| 34 | Cite BCEAO | 639 | 100 | 0 | 145 | 93 | 0 | 75 | 70 |
| 35 | Cite Foire Nord | 3,342 | 100 | 0 | 91 | 304 | 0 | 80 | 243 |
| 36 | Cite Adama Diop | 370 | 100 | 0 | 199 | 74 | 0 | 75 | 56 |
| 37 | Lotissement Djily Mbaye | 1,284 | 100 | 0 | 199 | 256 | 0 | 75 | 192 |
| 38 | Cite Diamalaye | 9,007 | 0 | 0 | 91 | 820 | 0 | 80 | 0 |
| 39 | Cimetiere | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 39 b | Cite BCEAO (cadres) | 239 | 100 | 0 | 145 | 35 | 0 | 75 | 26 |
| 40 | H.L.M. Grand Medine | 1,830 | 90 | 0 | 91 | 167 | 0 | 80 | 120 |
| 41 | Stade Amitie | 0 | 100 | 25 | 150 | 4 | 0 | 80 | 3 |
| 42 | Grand Medine | 16,130 | 0 | 0 | 39 | 629 | 0 | 85 | 0 |
| 43 | H.L.M. Grand Yoff/Khar Yalla | 4,750 | 100 | 0 | 125 | 594 | 0 | 80 | 475 |
| 43 b | SCAT-URBAM | 13,882 | 0 | 0 | 125 | 1,735 | 0 | 80 | 0 |
| 44 | H.L.M. Patte d'Oie | 6,648 | 100 | 0 | 125 | 831 | 0 | 80 | 665 |
| 45 | Grand Yoff/Khar Yalla | 42,138 | 5 | 0 | 79 | 3,329 | 0 | 85 | 141 |
| 82 | Equipements (CEREEG) | 0 | 0 | 100 | 150 | 15 | 0 | 80 | 0 |
| 83 | Habitat Grand Standing | 1,237 | 0 | 0 | 275 | 340 | 0 | 75 | 0 |
| 84 | Prison Fort B | 0 | 0 | 200 | 150 | 30 | 0 | 80 | 0 |
| 85 | Parc Zoologique, ISRA | 0 | 0 | 1,000 | 150 | 150 | 0 | 80 | 0 |
| 86 | Cite Ady Niang | 1,587 | 0 | 0 | 199 | 316 | 0 | 75 | 0 |
| 87 | Equip. SENELEC Ecole | 0 | 0 | 250 | 150 | 38 | 0 | 80 | 0 |
| 88 | Petite Cite | 95 | 0 | 0 | 199 | 19 | 0 | 75 | 0 |
| 89 | SICAP 2 | 0 | 0 | 0 | 125 | 0 | 0 | 80 | 0 |
| 98 | Cite Builders | 6,936 | 100 | 0 | 91 | 631 | 0 | 80 | 505 |
| 99 | Lotis. Impots et Domaine | 3,461 | 100 | 0 | 91 | 315 | 0 | 80 | 252 |
| 100 | SOPRIM | 2,412 | 100 | 0 | 91 | 219 | 0 | 80 | 175 |
| 101 | Parcelles Assainies | 123,905 | 25 | 0 | 58 | 7,186 | 0 | 85 | 1,527 |
| 90 | Dalifort | 7,779 | 0 | 0 | 65 | 506 | 0 | 85 | 0 |
| 91 | HACIENDA | 567 | 0 | 0 | 241 | 137 | 0 | 75 | 0 |
| 94 | Cite Faycal | 404 | 100 | 0 | 145 | 59 | 0 | 75 | 44 |
| 94 Ç | TECHNOPOLE | 0 | 0 | 12,250 | 100 | 0 | 0 | 80 | 0 |
| 95 | St. de Epuration Camberene | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 96 | Ecole d'Horticulture | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 97 | Direction Espaces Verts | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 103 | Lotissements en Cours | 543 | 0 | 0 | 125 | 68 | 0 | 80 | 0 |
| 104 | Lotissements en Cours | 1,129 | 0 | 0 | 125 | 141 | 0 | 80 | 0 |
| 104 b | CADMI | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 104 t | Marche aux Poissons | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 105 | HAMO | 4,521 | 0 | 0 | 92 | 416 | 0 | 80 | 0 |
| 111 | Pikine Regulier | 85,300 | 0 | 0 | 96 | 8,189 | 0 | 85 | 0 |
| 112 | Cite Lobatt Fall | 757 | 0 | 0 | 151 | 114 | 0 | 80 | 0 |
| 113 | Gare Routiere | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 114 | Cite ICOTAF | 49 | 100 | 0 | 241 | 12 | 580 | 75 | 444 |
| 119 | Guinaw Rail | 47,887 | 0 | 0 | 98 | 4,693 | 0 | 85 | 0 |
| 120 | Equip. SOTRAC, OPCE, SO | 0 | 0 | 0 | | 0 | 634 | 80 | 0 |
| 128 | Pikine Irregulire, Thiaroye | 98,708 | 0 | 0 | 65 | 6,416 | 0 | 85 | 0 |
| | sub-total | 487,536 | 13 | 14,860 | 78 | 39,037 | 1,214 | | 5,051 |
| 9 | Cite ASECNA | 1,509 | 100 | 0 | 125 | 189 | 0 | 80 | 151 |
| 10 | Cite Assemblee | 3,922 | 100 | 0 | 125 | 490 | 0 | 80 | 392 |
| 11 | Cite ASECNA (habitat eco.) | 1,911 | 100 | 0 | 125 | 239 | 0 | 80 | 191 |
| 12 | Equipements | 0 | 0 | 25 | 150 | 4 | 0 | 80 | 0 |
| 13 | Equipements (elevage) | 0 | 100 | 25 | 150 | 4 | 0 | 80 | 3 |
| 14 | Cite ASECNA (cadres) | 869 | 100 | 0 | 199 | 173 | 0 | 75 | 130 |
| 15 | Terrain de Sports | 0 | 0 | 50 | 150 | 8 | 0 | 80 | 0 |
| 16 | Zone mil. Camp ARCHIN | 0 | 100 | 200 | 150 | 30 | 0 | 75 | 23 |
| 17 | Village de Ouakam | 22,223 | 0 | 0 | 54 | 1,200 | 0 | 85 | 0 |
| 18 | Base Aerienne Terme Sud | 0 | 100 | 100 | 150 | 15 | 0 | 75 | 11 |
| 19 | Cite des Douanes | 8,805 | 0 | 0 | 125 | 1,101 | 0 | 80 | 0 |
| 20 | Quartir Touba Ouakam | 10,674 | 0 | 0 | 54 | 576 | 0 | 85 | 0 |
| 21 | Ter. Mil. Ecole Gendarmerie | 0 | 100 | 1,000 | 150 | 150 | 0 | 75 | 113 |
| 22 | Equipements | 0 | 0 | 0 | | 0 | 0 | 75 | 0 |
| 23 | Cite Africa | 1,528 | 100 | 0 | 244 | 373 | 0 | 75 | 280 |
| | sub-total | 51,441 | 19 | 1,400 | 86 | 4,552 | 0 | | 1,294 |

# TABLE B.1.3 (3) PRESENT WASTEWATER FLOW (PRODUCTION AND COLLECTED BY SEWERAGE) (1993)

(3/3)

| No. | Unit Name | Pop. | Conn.R.(%) | Pop.Eq. | (lpcd) | Domestic | Industrial | Dis.R.(%) | Flow |
|---|---|---|---|---|---|---|---|---|---|
| 106 | Equipement Militaire | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 107 | Lotissement Golf Nord | 418 | 100 | 0 | 198 | 83 | 0 | 75 | 62 |
| 108 | Terrain de Golf | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 108 b | Cite Golf Sud | 12,525 | 0 | 0 | 79 | 989 | 0 | 85 | 0 |
| 109 | Cite Adama Diop HAMO | 4,581 | 0 | 0 | 124 | 568 | 0 | 85 | 0 |
| 109 b | H.L.M. Guediawaye | 9,416 | 90 | 0 | 126 | 1,186 | 0 | 80 | 854 |
| 110 | Niayes | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 112 b | Cite SOTIBA | 2,917 | 100 | 0 | 151 | 440 | 0 | 80 | 352 |
| 129 | Pikine Guediawaye | 131,572 | 0 | 0 | 79 | 10,394 | 0 | 85 | 0 |
| 130 | Cite HAMO | 1,760 | 0 | 0 | 124 | 218 | 0 | 80 | 0 |
| 130 b | Cite Adama Diop/Barry | 1,440 | 0 | 0 | 124 | 179 | 0 | 80 | 0 |
| 131 | Golf Guediawaye | 4,558 | 0 | 0 | 79 | 360 | 0 | 75 | 0 |
| 132 | Lotissement | 705 | 0 | 0 | 124 | 87 | 0 | 80 | 0 |
| 133 | Lotissement en Cours | 488 | 0 | 0 | 124 | 61 | 0 | 80 | 0 |
| 134 | Lotissment | 787 | 0 | 0 | 124 | 98 | 0 | 75 | 0 |
| | sub-total | 171,167 | 7 | 0 | 86 | 14,663 | 0 | | 1,268 |
| 121 | Camp Militaire Faidherbe | 0 | 0 | 0 | 150 | 0 | 0 | 80 | 0 |
| 121 b | Redevelopment of 121, 81.6 ha | 0 | 0 | 50,000 | 150 | 7,500 | 0 | 80 | 0 |
| 124 | Cite Tivaoune | 10,070 | 0 | 0 | 65 | 655 | 0 | 85 | 0 |
| 125 | Diaksao 1 | 16,423 | 0 | 0 | 65 | 1,067 | 0 | 85 | 0 |
| 126 | Diaksao 2 | 25,931 | 0 | 0 | 65 | 1,686 | 0 | 80 | 0 |
| 127 | Lotissement Rochette | 1,031 | 0 | 0 | 95 | 98 | 0 | 85 | 0 |
| 135 | Centre Transmission As | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 136 | Centre Transmission Ar | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 137 | Village de Malika | 18,160 | 0 | 0 | 65 | 1,180 | 0 | 85 | 0 |
| 138 | Extension Village de Malika | 9,810 | 0 | 0 | 65 | 638 | 0 | 85 | 0 |
| 139 | Centre Emetteur SONATEL | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 140 | Village de Keur Massar | 2,891 | 0 | 0 | 65 | 188 | 0 | 85 | 0 |
| 141 | Village Keur Abdou | 2,630 | 0 | 0 | 65 | 171 | 0 | 85 | 0 |
| 142 | Centre Evangelique | 0 | 0 | 0 | | 0 | 0 | 85 | 0 |
| 142 b | Parcelles Assainies de Malika | 0 | 0 | 0 | 124 | 0 | 0 | 80 | 0 |
| 143 | Village de Yeumbeul | 82,736 | 0 | 0 | 55 | 4,550 | 0 | 85 | 0 |
| 144 | Village de Boune | 3,081 | 0 | 0 | 65 | 200 | 0 | 85 | 0 |
| 145 | SICAP Mbao | 2,843 | 0 | 0 | 151 | 429 | 0 | 80 | 0 |
| 146 | Foirail | 0 | 0 | 0 | | 0 | 0 | 80 | 0 |
| 147 | Fass Mbao | 4,368 | 0 | 0 | 96 | 419 | 0 | 85 | 0 |
| 148 | Diamaguene. | 42,266 | 0 | 0 | 65 | 2,747 | 0 | 85 | 0 |
| 149 | Cite SABE | 443 | 0 | 0 | 241 | 107 | 0 | 75 | 0 |
| 150 | LGI (Gendarmerie) | 0 | 0 | 500 | 150 | 75 | 0 | 75 | 0 |
| 151 | Centre Institut Pasteur | 0 | 0 | 50 | 150 | 8 | 0 | 80 | 0 |
| 152 | Cite Gueye | 789 | 0 | 0 | 151 | 119 | 0 | 80 | 0 |
| 154 | Village Mbao Goundao | 2,821 | 0 | 0 | 65 | 183 | 0 | 85 | 0 |
| 155 | Village Grand Mbao | 6,322 | 0 | 0 | 65 | 411 | 0 | 85 | 0 |
| 156 | Centre National d'Aviculture | 0 | | 0 | | 0 | 0 | 80 | 0 |
| 157 | Village de Kamb Goundao | 3,907 | 0 | 0 | 65 | 254 | 0 | 80 | 0 |
| 158 | Foret Classee de Mbao | 0 | | 0 | | 0 | 0 | 0 | 0 |
| | sub-total | 236,522 | 0 | 50,550 | 79 | 22,685 | 0 | | 0 |
| 1 | Equip. Tourist. Almadies | 0 | 0 | 3,000 | 150 | 450 | 0 | 80 | 0 |
| 2 | OCI | 0 | 0 | 100 | 150 | 15 | 0 | 75 | 0 |
| 3 | Remembrement Almadies | 5,757 | 0 | 0 | 199 | 1,146 | 0 | 75 | 0 |
| 4 | Village de Ngor | 7,400 | 0 | 0 | 54 | 400 | 0 | 85 | 0 |
| 5 | Zone Touristique Ngor | 0 | 0 | 2,500 | 150 | 375 | 0 | 75 | 0 |
| 6 | Habitat Grand Standing Ngor | 313 | 0 | 0 | 199 | 62 | 0 | 75 | 0 |
| 7 | Ranrhar | 7,807 | 0 | 0 | 199 | 1,554 | 0 | 75 | 0 |
| 7 b | Village de Yoff | 36,015 | 0 | 0 | 54 | 1,945 | 0 | 85 | 0 |
| 8 | Aeroport | 0 | 0 | 500 | 150 | 75 | 0 | 25 | 0 |
| 102 | Village de Camberene | 23,607 | 0 | 0 | 39 | 921 | 0 | 85 | 0 |
| | sub-total | 80,899 | 0 | 6,100 | 80 | 6,943 | 0 | | 0 |
| 159 | Zone Speciale de Mbao Gare | 0 | 0 | 0 | 150 | 0 | 0 | 80 | 0 |
| | Grand Total | 1,517,400 | 30 | 128,885 | 102 | 168,074 | 12,914 | | 66,210 |

Source : Study Team

## TABLE B.1.4 RESULTS OF UNIT DOMESTIC POLLUTION LOAD ANALYSIS

| Sampling Area | Housing Type | Per Capita Water consumption | Concentration ( mg/l ) | | | Unit Pollutant Load ( gpcd ) | | |
|---|---|---|---|---|---|---|---|---|
| | | ( lpcd ) | BOD | COD | SS | BOD | COD | SS |
| Point E | 5 | 140 | 480 | 910 | 220 | 67.2 | 127.4 | 30.8 |
| SICAP Dleupeul | 4 | 60 | 640 | 1000 | 180 | 38.4 | 60 | 10.8 |
| SICAP Baobabs | 4 | 60 | 680 | 1070 | 320 | 40.8 | 64.2 | 19.2 |
| Bentali | 3 | 50 | 840 | 1620 | 300 | 42 | 81 | 15 |
| Pikine | 3 | 60 | 200 | 270 | 120 | 12 | 16.2 | 7.2 |
| Fass | 6 | 70 | 320 | 860 | 270 | 22.4 | 60.2 | 18.9 |
| Average (whole) | | 70 | 530 | 960 | 240 | 37.1 | 68.2 | 17 |
| Average * | | 80 | 660 | 1150 | 260 | 47.1 | 83.2 | 19 |

Note ; * : Average of 4 areas ( Point E, SICAP Dleupeul, SICAP Baobabs, and Bentali ) is considered to be representative, because figures for 2 areas ( Pikine and Fass ) are too low.

Source : Study Team

## TABLE B.1.5 RESULTS OF INDUSTRIAL WASTEWATER CHARACTERISTIC ANALYSIS AND TYPICAL BOD AND SS CONCENTRATIONS IN JAPAN

| Name of factory | Results of Analysis | | | | | | | Japan | |
|---|---|---|---|---|---|---|---|---|---|
| | pH | Conductivity (micro-mho/cm) | BOD (mg/l) | COD (mg/l) | SS (mg/l) | Coli. group( n/ml ) (Total) | (Fecal) | BOD (mg/l) | SS (mg/l) |
| S.N.C.D.S. | 6.8 | 648 | 280 | 190 | 8 | 4.2*10^5 | 1.5*10^5 | 3250 | 2370 |
| AFRICA AZOTE | 6.6 | 52000 | 250 | - | 800 | - | - | 3250 | 2370 |
| NESTLE SENEGAL | 8.2 | 670 | 280 | 450 | 130 | 6.8*10^3 | 2.1*10^3 | 280 | 100 |
| SAPROLAIT | 8.3 | 1980 | 230 | 1930 | 22 | - | - | 280 | 100 |
| SOBOA | 10.1 | 673 | 150 | 67 | 1 | - | - | 620 | 400 |
| SENEGAL PROTEINES | 6.9 | 3500 | 190 | 350 | 85 | 6.8*10^4 | 2.3*10^4 | 2400 | 850 |
| SOFRAVIN | 7.5 | 720 | 130 | 190 | 40 | - | - | 340 | 370 |
| MTOA | 8.5 | 820 | 280 | 720 | 250 | 1.5*10^3 | 8.0*10^2 | 150 | 170 |
| BLANCHISSERIE DU CYGNE | 8.9 | 1720 | 350 | 340 | 290 | 1.0*10^3 | 3.0*10^2 | 760 | 740 |
| LA ROCHETTE DAKAR | 5.8 | 1800 | 220 | 1250 | 350 | 3.6*10^4 | 6.5*10^3 | 2500 | 8000 |
| SAR | 7.0 | 2830 | 30 | 220 | 12 | 1.3*10^3 | 6.0*10^2 | 200 | 50 |
| PARKE DAVIS AFRIQUE OUEST | 6.5 | 800 | 70 | 150 | 80 | 4.2*10^3 | 8.5*10^2 | 830 | 100 |
| SIPOA | 6.2 | 604 | 125 | 210 | 820 | 8.0*10^4 | 7.7*10^3 | 830 | 100 |
| NSOA | 8.8 | 1200 | 650 | 2200 | 420 | - | - | 490 | 170 |
| S.A.F. | 10.5 | 1650 | 900 | 3850 | 1270 | - | - | 490 | 170 |
| I.C.S. | 1.2 | 52000 | 250 | - | 1300 | - | - | 60 | 1400 |
| DAKAR MARINE | 6.9 | 1600 | 150 | 440 | 100 | 1.5*10^5 | 8.2*10^4 | 10 | 100 |
| Q - FONDS | 6.2 | 750 | 40 | 90 | 140 | 2.4*10^3 | 7.2*10^2 | 20 | 20 |
| SENELEC | 6.7 | 55000 | 40 | - | 10 | - | - | - | - |
| Average ( 19 factories ) | 7.2 | 9500 | 240 | 800 | 320 | 7.0*10^4 | 2.5*10^4 | 920 | 1010 |
| ABATTOIRS DE DAKAR (SERAS) | 6.4 | 2960 | 6000 | 6070 | 120 | 2.3*10^7 | 2.0*10^6 | - | - |

Source : Study Team

## TABLE B.1.6 BOD LOAD GENERATED AND COLLECTED BY SEWERAGE

(unit : kg/day)

| District | BOD Generated | | | BOD Collected |
|---|---|---|---|---|
| | Domestic | Iudustrial | Total | (Domestic) |
| Cap Manuel | 2,755 | 0 | 2,755 | 1,938 |
| Hann-Fann | 16,634 | 0 | 16,634 | 16,719 |
| Baie de Hann | 4,269 | 10,646 | 14,915 | 7,867 |
| Camberene | 23,034 | 1,105 | 24,139 | 3,641 |
| Secteur Ouest | 2,483 | 0 | 2,483 | 520 |
| Pikine Niayes | 8,046 | 0 | 8,046 | 556 |
| Secteur Est | 13,495 | 0 | 13,495 | 0 |
| Villages | 4,092 | 0 | 4,092 | 0 |
| total | 76,808 | 11,751 | 88,559 | 31,241 |

Source : Study Team

## TABLE B.1.7 OPERATION RECORDS OF PUMPING STATIONS

| Name of Pumping Station | 1991 | | | | 1992 | | | |
|---|---|---|---|---|---|---|---|---|
| | Annual Operating Hours (hr) | Total Power Consumption (kwh) | Total Volume Pumped (m3) | Unit Power Consumption (kwh/m3) | Annual Operating Hours (hr) | Total Power Consumption (kwh) | Total Volume Pumped (m3) | Unit Power Consumption (kwh/m3) |
| MERMOZ | 1,465 | 5,989 | 105,492 | 0.05 | 990 | 3,913 | 63,121 | 0.06 |
| UNIVERSITE | 3,253 | 172,680 | 2,782,005 | 0.06 | 3,776 | 134,418 | 2,141,181 | 0.06 |
| SOUMBEDIOUNE | 4,576 | 81,610 | 2,068,262 | 0.03 | 5,675 | 123,121 | 2,655,364 | 0.04 |
| MALICK SY | 157 | 9,763 | 231,530 | 0.04 | 1,083 | 11,474 | 247,439 | 0.04 |
| RUE 10 | 1,787 | 25,843 | 564,818 | 0.04 | 2,054 | 25,672 | 557,990 | 0.04 |
| NIMZATT | 378 | 5,188 | 48,816 | 0.10 | 344 | 4,738 | 49,913 | 0.09 |
| OUAGOUNIAYES | 1,357 | 7,524 | 187,916 | 0.04 | 2,209 | 12,788 | 292,300 | 0.04 |
| ZONE INDUSTRIE | 1,720 | 17,714 | 395,485 | 0.04 | 2,268 | 23,577 | 521,665 | 0.04 |
| III B (GENIE RURAL) | 555 | 10,999 | 160,424 | 0.06 | 89 | 2,460 | 19,861 | 0.12 |
| FAYCAL | 411 | 717 | 19,742 | 0.03 | 941 | 1,639 | 45,152 | 0.03 |
| UNITE 9 | 162 | 1,208 | 9,083 | 0.13 | 155 | 1,184 | 8,674 | 0.13 |
| UNITE 15 | 4,372 | 60,575 | 336,393 | 0.18 | 5,395 | 75,479 | 388,754 | 0.19 |
| UNITE 23 | 1,452 | 9,441 | 60,627 | 0.15 | 1,436 | 9,301 | 59,967 | 0.15 |
| UNITE 17 | 595 | 3,166 | 12,797 | 0.24 | 406 | 2,717 | 13,150 | 0.20 |
| UNITE 22 | 1,530 | 4,722 | 38,233 | 0.12 | 1,109 | 3,451 | 29,011 | 0.11 |
| UNITE 7 | 693 | 4,446 | 71,425 | 0.06 | 831 | 5,269 | 80,594 | 0.06 |
| UNITE 13 | 3,403 | 41,901 | 443,948 | 0.09 | 3,325 | 42,902 | 530,384 | 0.08 |
| DJILY MBAYE | 175 | 4,955 | 21,918 | 0.22 | 192 | 5,840 | 24,179 | 0.24 |
| UNITE 2 | 1,528 | 18,630 | 78,294 | 0.23 | 1,455 | 20,965 | 89,961 | 0.23 |
| GUEDIAWAYE | 5,028 | 25,976 | 299,376 | 0.08 | 4,526 | 22,648 | 269,472 | 0.08 |
| XII (DOMINIQUE) | 291 | 3,387 | 36,386 | 0.09 | 441 | 3,813 | 55,521 | 0.06 |
| SOTIBA | 3,096 | 13,938 | 148,593 | 0.09 | 3,240 | 13,626 | 155,507 | 0.09 |
| Total | 37,984 | 530,272 | 8,121,565 | 0.07 | 42,140 | 550,995 | 8,299,160 | 0.07 |

Source : SONEES

## TABLE B.1.8 MONTHLY WASTEWATER FLOW TO CAMBERENE WASTE WATER TREATMENT PLANT 1990 TO 93

Unit : cu.m

| Month | 1990 | | | 1991 | | | 1992 | | | 1993 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Treated | Bypass | Total | Treated | Bypass | Total | Treated | Bypass | Total | Treated | Bypass |
| Jan. | 63743 | 63743 | 0 | 86889 | 86553 | 336 | 108518 | 103641 | 4877 | 123145 | 123145 | 0 |
| Feb. | 55000 | 55000 | 0 | 84253 | 77194 | 7059 | 104301 | 95639 | 8662 | 109165 | 109165 | 0 |
| Mar. | 62153 | 61817 | 336 | 89060 | 86790 | 2270 | 107272 | 106767 | 505 | 114542 | 114542 | 0 |
| Apr. | 69971 | 69971 | 0 | 81071 | 75438 | 5633 | 96881 | 95367 | 1514 | 102586 | 102586 | 0 |
| May | 104970 | 104970 | 0 | 91078 | 88556 | 2522 | 115129 | 114877 | 252 | 104024 | 104024 | 0 |
| Jun. | 33555 | 33555 | 0 | 95908 | 92292 | 3616 | 110422 | 110422 | 0 | 121355 | 119337 | 2018 |
| Jul. | 131201 | 130360 | 841 | 36610 | 36442 | 168 | 126854 | 124584 | 2270 | 136662 | 133971 | 2691 |
| Aug. | 292330 | 285434 | 6896 | 77118 | 76530 | 588 | 0 | 0 | 0 | 119207 | 114329 | 4878 |
| Sep. | 175260 | 175092 | 168 | 129259 | 126652 | 2607 | 140384 | 128979 | 11405 | - | - | - |
| Oct. | 99419 | 97648 | 1771 | 142429 | 136920 | 5509 | 113870 | 108992 | 4878 | - | - | - |
| Nov. | 119837 | 99149 | 20688 | 96089 | 94454 | 1635 | 108949 | 106847 | 2102 | - | - | - |
| Dec. | 90829 | 87970 | 2859 | 117236 | 115638 | 1598 | 108824 | 106890 | 1934 | - | - | - |
| Total | 1298268 | 1264709 | 33559 | 1127000 | 1093459 | 33541 | 1241404 | 1203005 | 38399 | 930686 | 921099 | 9587 |
| Daily Av. | 3875 | 3775 | 100 | 3395 | 3294 | 101 | 3717 | 3602 | 115 | 3944 | 3903 | 41 |
| | No. of data = | 335 | | No. of data = | 332 | | No. of data = | 334 | | No. of data = | 236 | |

Source : SONEES

## TABLE B.1.9 RESULTS OF WATER QUANTITY/ ANALYSIS AT CAMBERENE WASTE WATER TREATMENT PLANT (1992)

( unit : mg/l )

| Date | Raw Sewage | | | Primary Effluent | | | Secondary Effluent | | |
|---|---|---|---|---|---|---|---|---|---|
| | BOD | COD | SS | BOD | COD | SS | BOD | COD | SS |
| Jan. 1 | 525 | - | 382 | 300 | - | 61 | 100 | - | 5 |
| 3 | 775 | - | 798 | 365 | - | 262 | 95 | - | 8 |
| 9 | 425 | - | 748 | 225 | - | | 55 | - | 21 |
| 14 | 675 | - | 1154 | 305 | - | 137 | 0 | - | 30 |
| 19 | 953 | - | 608 | 336 | - | 24 | 37 | - | 14 |
| 23 | 800 | - | 894 | 335 | - | 36 | 0 | - | 8 |
| Feb. 3 | 475 | 1193 | 578 | 250 | 422 | 15 | 140 | 55 | 12 |
| 7 | 725 | - | 373 | 275 | - | 27 | 5 | - | 10 |
| 8 | 725 | - | 695 | 275 | - | 4 | 5 | - | 1 |
| 11 | 375 | - | 1307 | 175 | - | 194 | 140 | - | 25 |
| 12 | 375 | - | 1531 | 175 | - | 75 | 140 | - | 13 |
| 15 | 875 | - | 1060 | 320 | - | 242 | 150 | - | 112 |
| 26 | 175 | - | 215 | - | - | - | - | - | - |
| Mar. 5 | - | 2017 | 693 | 200 | 435 | 60 | 130 | 278 | 31 |
| 6 | 700 | - | 1175 | 275 | - | 181 | 100 | - | 27 |
| 10 | 625 | - | 482 | 175 | - | 30 | 20 | - | 5 |
| 14 | 500 | - | 1464 | 190 | - | 153 | 45 | - | 27 |
| 18 | 725 | - | 607 | 280 | - | 24 | 5 | - | 5 |
| 22 | 575 | - | 654 | 220 | - | 79 | 5 | - | 8 |
| 24 | 775 | - | 853 | 800 | - | 688 | | - | |
| Apr. 3 | 475 | - | 501 | 300 | - | 64 | 5 | - | 20 |
| 7 | 600 | 1079 | 693 | 200 | 381 | 112 | 5 | 79 | 41 |
| 9 | - | 1143 | 493 | 315 | 905 | 89 | 30 | 114 | 2 |
| 11 | 625 | - | 760 | 255 | - | 21 | 5 | - | 17 |
| 13 | - | 1480 | 387 | 320 | 425 | 51 | 40 | 94 | 28 |
| 15 | 625 | 1547 | 702 | 230 | 297 | 20 | 5 | 31 | 6 |
| 19 | 725 | - | 665 | 275 | - | 85 | 5 | - | 5 |
| 24 | 525 | - | 463 | 200 | - | 50 | 0 | - | 17 |
| 27 | 675 | - | 687 | 190 | - | 73 | 5 | - | 5 |
| May 1 | 225 | - | 445 | 95 | - | 24 | 5 | - | 15 |
| 5 | 450 | - | 913 | 155 | - | 462 | 20 | - | 7 |
| 13 | 675 | - | 827 | 155 | - | 71 | 5 | - | 11 |
| 17 | 200 | - | 481 | 150 | - | 32 | 15 | - | 20 |
| 21 | 375 | 822 | 283 | 225 | 356 | 31 | 5 | 82 | 10 |
| 23 | 425 | - | 284 | 325 | - | 156 | 35 | - | 21 |
| 25 | 700 | 1135 | 623 | 300 | 730 | 86 | 15 | 67 | 30 |
| 30 | 550 | - | 516 | 365 | - | 127 | 5 | - | 19 |
| Jun. 2 | 525 | - | 708 | 235 | - | 111 | 20 | - | 13 |
| 6 | 600 | - | 736 | 300 | - | 93 | 20 | - | 11 |
| 10 | 525 | - | 921 | 225 | - | 348 | 10 | - | 50 |
| 18 | 770 | - | 651 | 330 | - | 39 | 90 | - | 6 |
| 24 | 790 | 1449 | 657 | 255 | 510 | 42 | 30 | 92 | 9 |
| 30 | 730 | - | 747 | 275 | - | 22 | 45 | - | 5 |
| Jul. 8 | 325 | - | 348 | 270 | - | 38 | 10 | - | 14 |
| 14 | 550 | 823 | 409 | 280 | 372 | 18 | 20 | 59 | 9 |
| 20 | 510 | 1192 | 765 | 195 | 308 | 120 | 5 | 38 | 14 |
| 22 | - | 923 | 531 | - | 442 | 118 | - | 58 | 18 |
| 24 | 470 | - | 559 | 300 | - | 88 | 40 | - | 6 |
| Aug. 11 | 600 | - | 372 | 350 | - | 71 | 170 | - | 16 |
| 17 | 525 | - | 706 | 280 | - | 86 | 45 | - | 39 |
| 19 | 250 | - | 217 | 80 | - | 67 | 55 | - | 34 |
| 25 | 425 | - | 509 | 275 | - | 200 | 60 | - | 56 |
| Sep. 20 | 525 | 727 | 304 | 245 | 297 | 48 | 55 | 83 | 6 |
| 30 | 600 | 1516 | 506 | 230 | 387 | 116 | 125 | 210 | 48 |
| Oct. 7 | 775 | - | 732 | 190 | - | 194 | 40 | - | 9 |
| 12 | 700 | - | 524 | 185 | - | 72 | 75 | - | 20 |
| Dec. 15 | 800 | 1257 | 940 | 255 | 324 | 89 | 10 | 38 | 5 |

Source : SONEES

1994/7/2011:28

## TABLE B.1.10 SUMMARY OF WATER QUALITY ANALYSIS AT CAMBERENE WASTE WATER TREATMENT PLANT (1992)

| Water Quality Items | | Concentration ( mg/l ) | | | Reduction ( % ) | | |
|---|---|---|---|---|---|---|---|
| | | Raw Sewage ( A ) | Primary Effluent ( B ) | Secondary Effluent ( C ) | (A-B)/A | (B-C)/A | (A-C)/A |
| BOD | Average (Min.-Max.) | 600 (225-800) | 255 (150-350) | 20 (0-140) | 58 (25-72) | 37 (10-65) | 96 (71-99) |
| COD | Average (Min.-Max.) | 1140 (730-1550) | 380 (300-730) | 67 (31-210) | 65 (21-78) | 28 (8-56) | 93 (86-97) |
| SS | Average (Min.-Max.) | 654 (283-1175) | 73 (18-262) | 14 (5-48) | 87 (61-97) | 9 (2-32) | 98 (89-99) |
| T-N | - | 268 | 78 | 38 | 71 | 15 | 86 |
| PO4-P | - | 16 | 15 | 14 | 6 | 6 | 13 |

Source : SONEES

## TABLE B.1.11 OPERATION INDICATORS OF CAMBERENE WASTE WATER TREATMENT PLANT (1992)

| Items | Primary Sedimentation Tank | Aeration Tank | Final Sedimentation Tank |
|---|---|---|---|
| Surface Loading ( cu.m/sq.m. day ) | 10.7 ( 7.0 - 12.9 ) | _ | 6.5 ( 4.3 - 7.8 ) |
| Loading ( kg.BOD/kg.SS. day ) | _ | 0.07 ( 0.03 - 0.30 ) | _ |
| Detention Time ( hr ) | 3.7 ( 2.4 - 4.4 ) | 19.0 ( 12.6 - 22.9 ) | 2.0 ( 1.3 - 2.4 ) |
| MLSS ( mg/l ) | _ | 3200 ( 790 - 5500 ) | _ |
| Sludge Age ( day ) | _ | 45 ( 3 - 201 ) | _ |
| SVI | _ | 213 ( 59 - 322 ) | _ |

Note : Figures in parentheses indicate normal range adopted in Japan
Source : SONEES, Study Team

**TABLE B.1.12 ANNUAL OPERATION AND MAINTENANCE COST (CAMBERENE WASTE WATER TREATMENT PLANT, 1992)**

| | (Unit : FCFA) |
|---|---|
| I. Fixed Cost | |
| Remuneration | 26,804,379 |
| Day-to-day Work | 2,052,000 |
| Spare parts | 10,500,000 |
| Maintenance | 2,227,902 |
| Cleaning and Security | 5,520,000 |
| Laboratory Consumables | 165,000 |
| Sub-total | 47,269,281 |
| II. Variables | |
| Electricity | 63,133,608 |
| Diesel Oil | 527,100 |
| Lubricant | 530,000 |
| Chemicals | 2,732,350 |
| Sub-total | 66,923,058 |
| Total | 114,192,339 |

Source: SONEES

## TABLE B.1.13 PUBLIC INVESTMENT IN WATER SUPPLY/SANITATION (1)

(Unit : million FCFA)

| Scoters | Economic and Social Development Plan | | | |
|---|---|---|---|---|
| | 6th (81/82-84/85) | | 7th (85/86-88/89) | |
| Primary | 106,652 | (23.8%) | 208,300 | (38.1%) |
| Agriculture | 55,169 | (12.3%) | 77,300 | (14.1%) |
| Hydraulics | 10,703 | (2.4%) | 67,600 | (12.4%) |
| Fisheries | 11,414 | (2.6%) | 20,300 | (3.7%) |
| Water and Forest | 10,655 | (2.4%) | 20,800 | (3.8%) |
| Others | 18,228 | (4.1%) | 22,300 | (4.1%) |
| Secondary | 151,851 | (33.9%) | 79,300 | (14.5%) |
| Energy | 25,044 | (5.6%) | 46,100 | (8.4%) |
| Industries and Mining | 123,562 | (27.6%) | 28,600 | (5.2%) |
| Others | 3,248 | (0.7%) | 4,600 | (0.8%) |
| Tertiary | 99,281 | (22.2%) | 139,000 | (25.4%) |
| Transports and Telecommunications | 84,885 | (19.0%) | 133,600 | (24.4%) |
| Others | 14,396 | (3.2%) | 5,400 | (1.0%) |
| Fourth | 89,620 | (20.0%) | 120,200 | (22.0%) |
| Housing | 16,000 | (3.6%) | 23,100 | (4.2%) |
| Urban Hydraulics and Sanitation | 14,973 | (3.3%) | 34,000 | (6.2%) |
| Health and Social Welfare | 7,715 | (1.7%) | 18,500 | (3.4%) |
| Education and School Reform | 22,900 | (5.1%) | 18,600 | (3.4%) |
| Others | 28,032 | (6.3%) | 26,000 | (4.8%) |
| Total | 447,404 | (100.0%) | 546,700 | (100.0%) |

Source : Ministry of Planning and Cooperation

## TABLE B.1.14 PUBLIC INVESTMENT IN WATER SUPPLY/SANITATION (2)

(Unit : FCFA million)

| Sectors | Economic and Social Development Plan | | | |
|---|---|---|---|---|
| | 8th | | | |
| | (89/90-92) | | (93-95) | |
| Primary | 155,697 | (39.6%) | 119,894 | (24.8%) |
| Agriculture | 80,767 | (20.6%) | 61,205 | (12.7%) |
| Hydraulics | 20,756 | (5.3%) | 24,009 | (5.0%) |
| Fisheries | 8,683 | (2.2%) | 1,011 | (0.2%) |
| Water and Forests | 17,497 | (4.4%) | 6,582 | (1.4%) |
| Others | 27,994 | (7.1%) | 27,087 | (5.6%) |
| Secondary | 45,346 | (11.5%) | 71,935 | (14.9%) |
| Energy | 30,411 | (7.7%) | 31,619 | (6.5%) |
| Industries and Mining | 9,588 | (2.4%) | 29,555 | (6.1%) |
| Others | 5,347 | (1.4%) | 10,761 | (2.2%) |
| Tertiary | 70,332 | (17.9%) | 130,756 | (27.0%) |
| Transport and Communications | 68,365 | (17.4%) | 122,686 | (25.4%) |
| Others | 1,967 | (0.5%) | 8,070 | (1.7%) |
| Fourth | 121,585 | (30.9%) | 161,085 | (33.3%) |
| Housing | 20,505 | (5.2%) | 15,762 | (3.3%) |
| Urban Hydraulics and Sanitation | 10,817 | (2.8%) | 50,320 | (10.4%) |
| Health and Social Welfare | 25,888 | (6.6%) | 23,661 | (4.9%) |
| Education and School Reform | 13,311 | (3.4%) | 15,517 | (3.2%) |
| Others | 51,064 | (13.0%) | 55,825 | (11.5%) |
| Total | 392,960 | (100.0%) | 483,670 | (100.0%) |

Note : The figures for the period 1989/90 to 1992 are on the achievement basis, while those for the period 1993 to 1995 are on the budgetary basis.

Source : Ministère du Plan et de la Coopération

## TABLE B.1.15 INCOME STATEMENTS OF SONEES

(Unit : million FCFA)

| Item | 1989 | 1990 | 1991 |
|---|---|---|---|
| Revenues | | | |
| Water Bill | 13,137 | 14,077 | 14,305 |
| Bill for Works | | | |
| Water Supply | 332 | 160 | 182 |
| Sanitation | 2 | 39 | 12 |
| Others | 1 | 6 | 1 |
| Provision of Various Services | 110 | 149 | 259 |
| Rent | 2 | 3 | 4 |
| Works of the Company | 881 | 1,127 | 1,343 |
| Various Revenues and Profits | 97 | 5,124 | 3,069 |
| Financial Revenues | 5 | 25 | 965 |
| Subsidy for Operation | 0 | 0 | 45 |
| **Total Revenues** | **14,603** | **20,711** | **20,182** |
| | | | |
| **Costs of Operation** | | | |
| Materials and Supply | 4,846 | 5,272 | 5,736 |
| Transportation Costs | 98 | 101 | 136 |
| Costs of Other Services | 1,959 | 1,999 | 1,611 |
| Various Costs and Losses | 1,541 | 3,775 | 862 |
| Personnel Costs | 3,239 | 3,906 | 3,955 |
| Taxes | 249 | 267 | 443 |
| Payment of Interest | 726 | 1,004 | 2,039 |
| **Total Costs** | **12,658** | **16,324** | **14,782** |
| | | | |
| Operating Profits | 1,945 | 4,386 | 5,400 |
| Fund for Depreciation | -2,665 | -3,891 | -3,895 |
| Fund for Provision | -4,631 | -4,317 | -3,823 |
| Property Disposal | 2 | 7 | -6 |
| Refunding of Provision | 4,775 | 3,940 | 2,432 |
| Profits before Taxes | -574 | 125 | 108 |
| Taxes | 0 | 1 | 1 |
| Net Profits | -574 | 124 | 107 |

Source : SONEES

## TABLE B.1.16 MANAGEMENT ANALYSIS OF SONEES

| Management Index | Formula | Value in 1992 | Border Line Value |
|---|---|---|---|
| 1. Basic Ratios | | | |
| Financial independence | Proprietorship/Long term capital | 72.9% | > 50% |
| Repayment capacity | Middle & long term debt/Self financing capacity | 4.4 | < 10 |
| Liabilities potential | Total liabilities/Net par-value x 7.5 | 0.59 | < 1 |
| Liquidity | Net working fund/Gross working fund | 78.0% | > 10% |
| Profitability | Cash flow / Sales | 14.2% | > 5% |
| 2. Complementary Ratios | | | |
| 1) Financial Structure | | | |
| Weight of interest | Financial cost / Gross operating surplus | 12.6% | < 60% |
| Security of invested capital | Stable financing / invested capital | 100.0% | 100.0% |
| Part of banks in liabilities | Current bank credit / Total liabilities | 0.02 | < 1 |
| Cost of liabilities | Financial charges / Financial debt | 4.6% | < 20% |
| 2) Ratios of Results | | | |
| Rate of capital turnover | Value of stocks x 12 months / Sales | 1.4 | < 4 |
| Average period of credit to clients | Debtor clients x 12 months / Sales | 4.4 | < 3 |

Note : English translation in the above table is provisional.

Source : SONEES

## TABLE B.1.17 WATER TARIFFS OF SONEES

(Unit : FCFA/$m^3$)

| Structures | Sewered Area (A) | Unsewered Area (B) | (A-B) | (A-B)/B |
|---|---|---|---|---|
| Urban Consumers with Connections | | | | |
| Social Section | 113.91 | 113.91 | 0.00 | 0.0% |
| Normal Section | 389.15 | 366.92 | 22.23 | 6.1% |
| Disuasive Section | 446.92 | 421.35 | 25.57 | 6.1% |
| Public Stand | 166.20 | 141.45 | 24.75 | 17.5% |
| Gardening Crops Growers | | | | |
| 1st Section | 50.07 | 50.07 | 0.00 | 0.0% |
| 2nd Section | 70.42 | 70.42 | 0.00 | 0.0% |
| 3rd Section | 386.65 | 386.65 | 0.00 | 0.0% |

Source : SONEES

Note: The above are the pre-devaluation water tariffs.

# TABLE B.1.18 WASTEWATER DISPOSAL METHODS BY HOUSING TYPE

Type of discharge/storage of toilet

| Description | Type - 1 | | Type - 2 | | Type - 3 | | Type - 4 | | Type - 5 | | Type - 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) |
| Pit without lining | 0 | 0.0 | 1 | 4.5 | 2 | 3.6 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Pit with lining | 32 | 88.9 | 21 | 95.5 | 25 | 45.5 | 19 | 23.2 | 9 | 22.5 | 0 | 0.0 |
| Penetration with Septic Tank | 4 | 11.1 | 0 | 0.0 | 3 | 5.4 | 6 | 7.3 | 2 | 5.0 | 0 | 0.0 |
| Sewerage system | 0 | 0.0 | 0 | 0.0 | 25 | 45.5 | 57 | 69.5 | 29 | 72.5 | 6 | 100.0 |
| Total | 36 | 100.0 | 22 | 100.0 | 55 | 100.0 | 82 | 100.0 | 40 | 100.0 | 6 | 100.0 |

Type of toilet by Housing Types

| Description | Type - 1 | | Type - 2 | | Type - 3 | | Type - 4 | | Type - 5 | | Type - 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) |
| Simple toilets* | 1 | 2.2 | 0 | 0.0 | 2 | 3.6 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| WC (Turkish)** | 34 | 75.7 | 23 | 95.8 | 41 | 73.1 | 52 | 63.4 | 22 | 55.0 | 1 | 16.7 |
| WC (Western) | 2 | 4.4 | 0 | 0.0 | 9 | 16.1 | 30 | 36.6 | 18 | 45.0 | 4 | 66.6 |
| Public toilet | 2 | 4.4 | 0 | 0.0 | 2 | 3.6 | 0 | 0.0 | 0 | 0.0 | 1 | 16.7 |
| No toilet*** | 6 | 13.3 | 1 | 4.2 | 2 | 3.6 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| Total | 45 | 100.0 | 24 | 100.0 | 56 | 100.0 | 82 | 100.0 | 40 | 100.0 | 6 | 100.0 |

* : Toilet with no flushing

** : Toilet with flushing

*** : People go into bushes to do

Discharge of Laundry Water

| Description | Type - 1 | | Type - 2 | | Type - 3 | | Type - 4 | | Type - 5 | | Type - 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) |
| To the ground | 21 | 50.0 | 9 | 34.6 | 18 | 30.5 | 12 | 14.5 | 0 | 0.0 | 0 | 0.0 |
| To penetration pit | 0 | 0.0 | 0 | 0.0 | 1 | 1.7 | 4 | 4.8 | 1 | 2.5 | 0 | 0.0 |
| To roads | 12 | 28.6 | 11 | 42.3 | 10 | 16.9 | 0 | 0.0 | 2 | 5.0 | 1 | 16.7 |
| To penetration lot | 0 | 0.0 | 2 | 7.7 | 1 | 1.7 | 2 | 2.4 | 1 | 2.5 | 0 | 0.0 |
| To pit | 9 | 21.4 | 4 | 15.4 | 5 | 8.5 | 8 | 9.6 | 5 | 12.5 | 0 | 0.0 |
| To Sewerage System | 0 | 0.0 | 0 | 0.0 | 24 | 40.7 | 57 | 68.7 | 31 | 77.5 | 5 | 83.3 |
| Total | 42 | 100.0 | 26 | 100.0 | 59 | 100.0 | 83 | 100.0 | 40 | 100.0 | 6 | 100.0 |

Discharge of Kitchen Water

| Description | Type - 1 | | Type - 2 | | Type - 3 | | Type - 4 | | Type - 5 | | Type - 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) | Numbers | ( % ) |
| To the ground | 20 | 47.6 | 9 | 34.6 | 13 | 26.5 | 8 | 9.6 | 0 | 0.0 | 0 | 0.0 |
| To penetration pit | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 6 | 7.2 | 3 | 3.9 | 0 | 0.0 |
| To roads | 13 | 31.0 | 10 | 38.5 | 23 | 46.9 | 0 | 0.0 | 2 | 2.6 | 1 | 16.7 |
| To penetration lot | 0 | 0.0 | 2 | 7.7 | 2 | 4.1 | 5 | 6.0 | 1 | 1.3 | 0 | 0.0 |
| To pit | 9 | 21.4 | 5 | 19.2 | 4 | 8.2 | 8 | 9.6 | 3 | 3.9 | 0 | 0.0 |
| To Sewerage System | 0 | 0.0 | 0 | 0.0 | 7 | 14.3 | 56 | 67.6 | 67 | 88.3 | 5 | 83.3 |
| Total | 42 | 100.0 | 26 | 100.0 | 49 | 100.0 | 83 | 100.0 | 76 | 100.0 | 6 | 100.0 |

Type-1: Village
Type-2: Irregular spontaneous
Type-3: Regular spontaneous
Type-4: Planned
Type-5: Detached
Type-6: Flats

Source: Strategy Plan

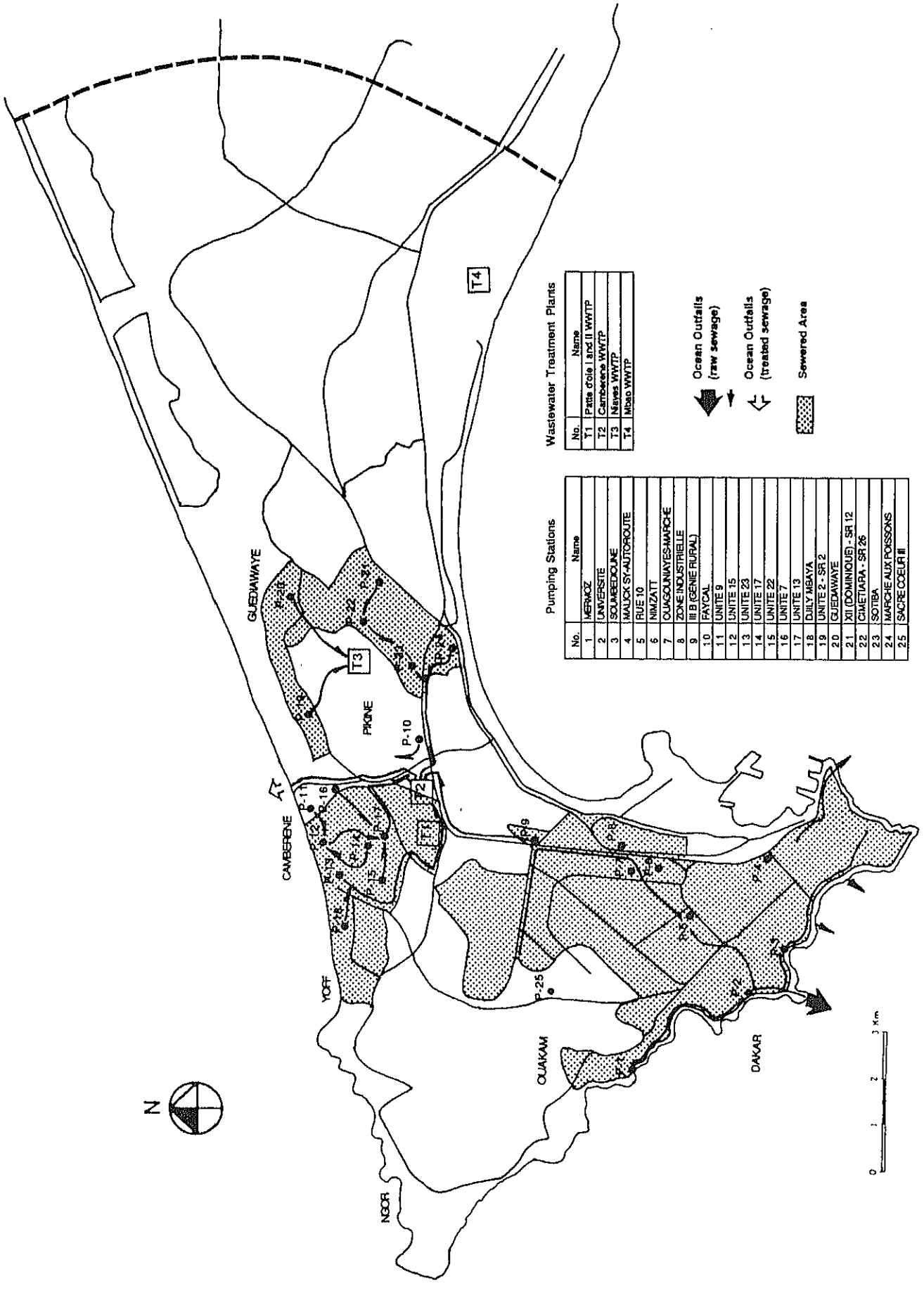



**FIGURE B.1.1 EXISTING SEWERAGE SYSTEM (1993)**

Data Source: SONEES

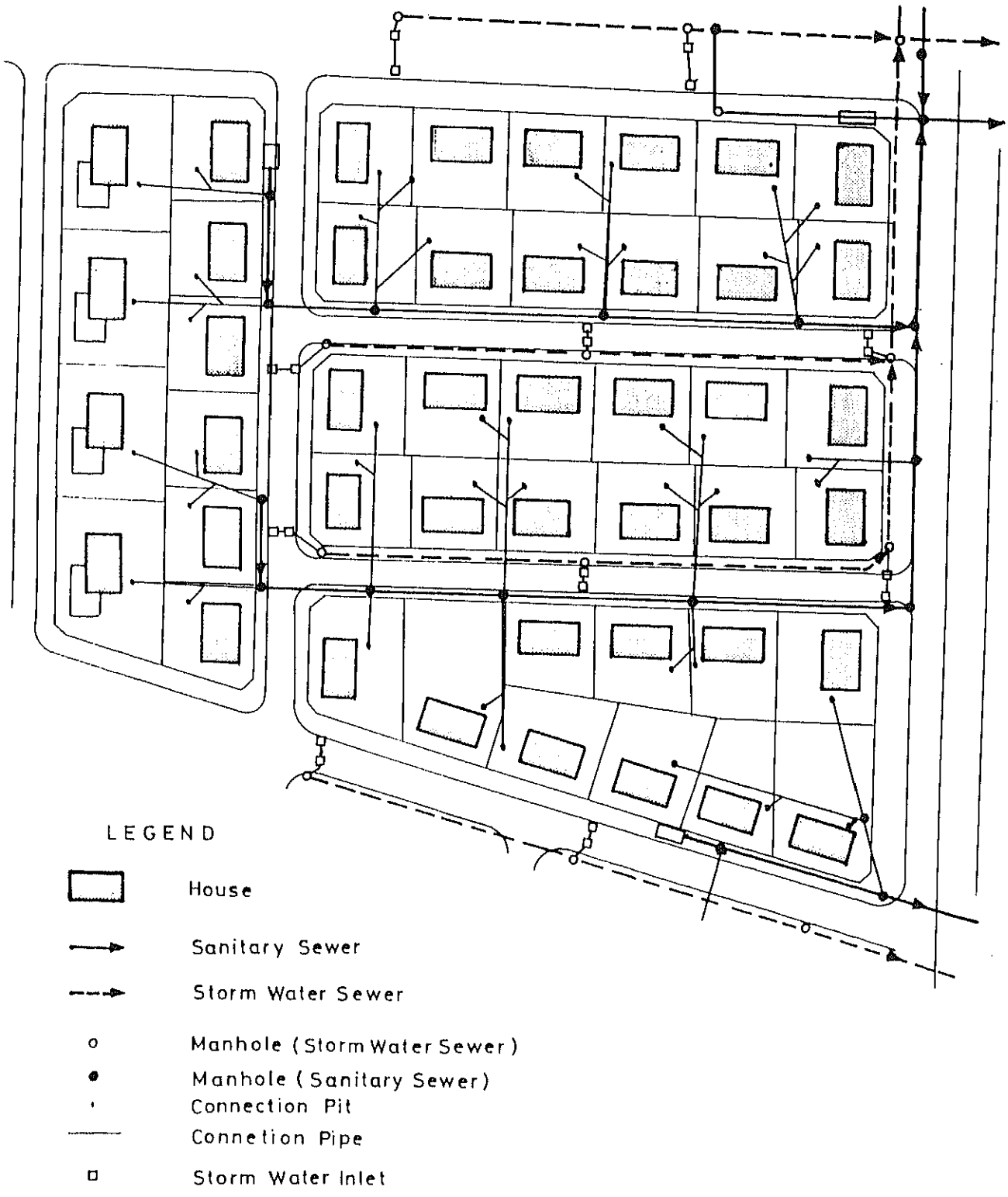



**FIGURE B.1.2 TYPICAL ARRANGEMENT OF SEWERS AND APPURTENANCES**

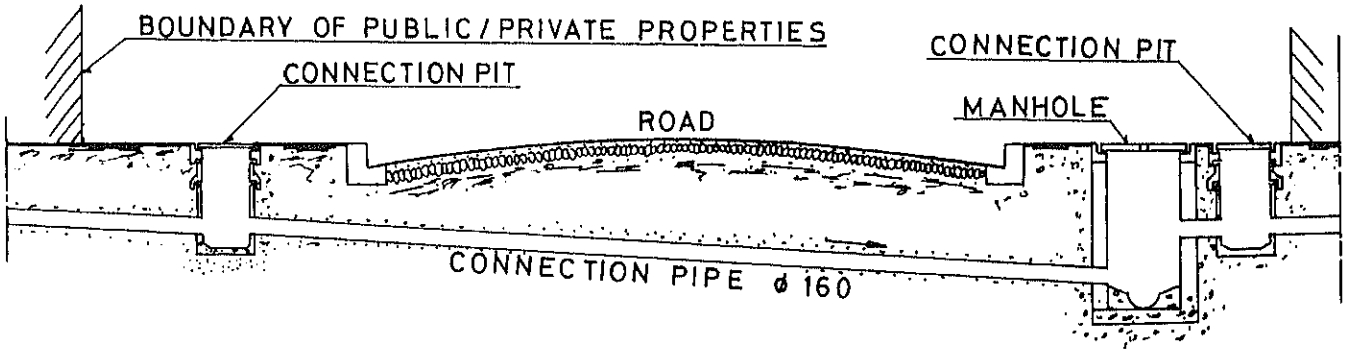



**FIGURE B.1.3 TYPICAL HOUSE CONNECTION (CROSS SECTION)**

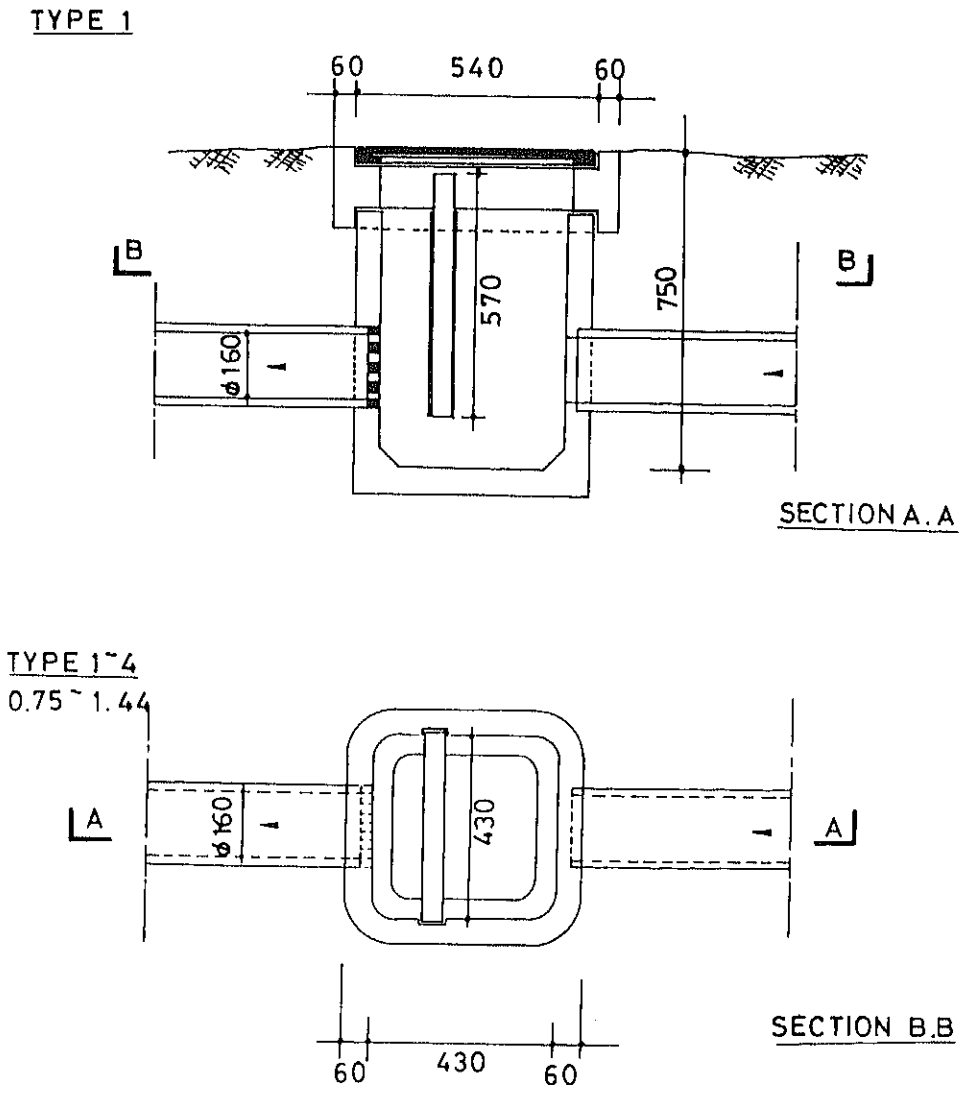



**FIGURE B.1.4 TYPICAL CONNECTION PIT (SHALLOWEST)**

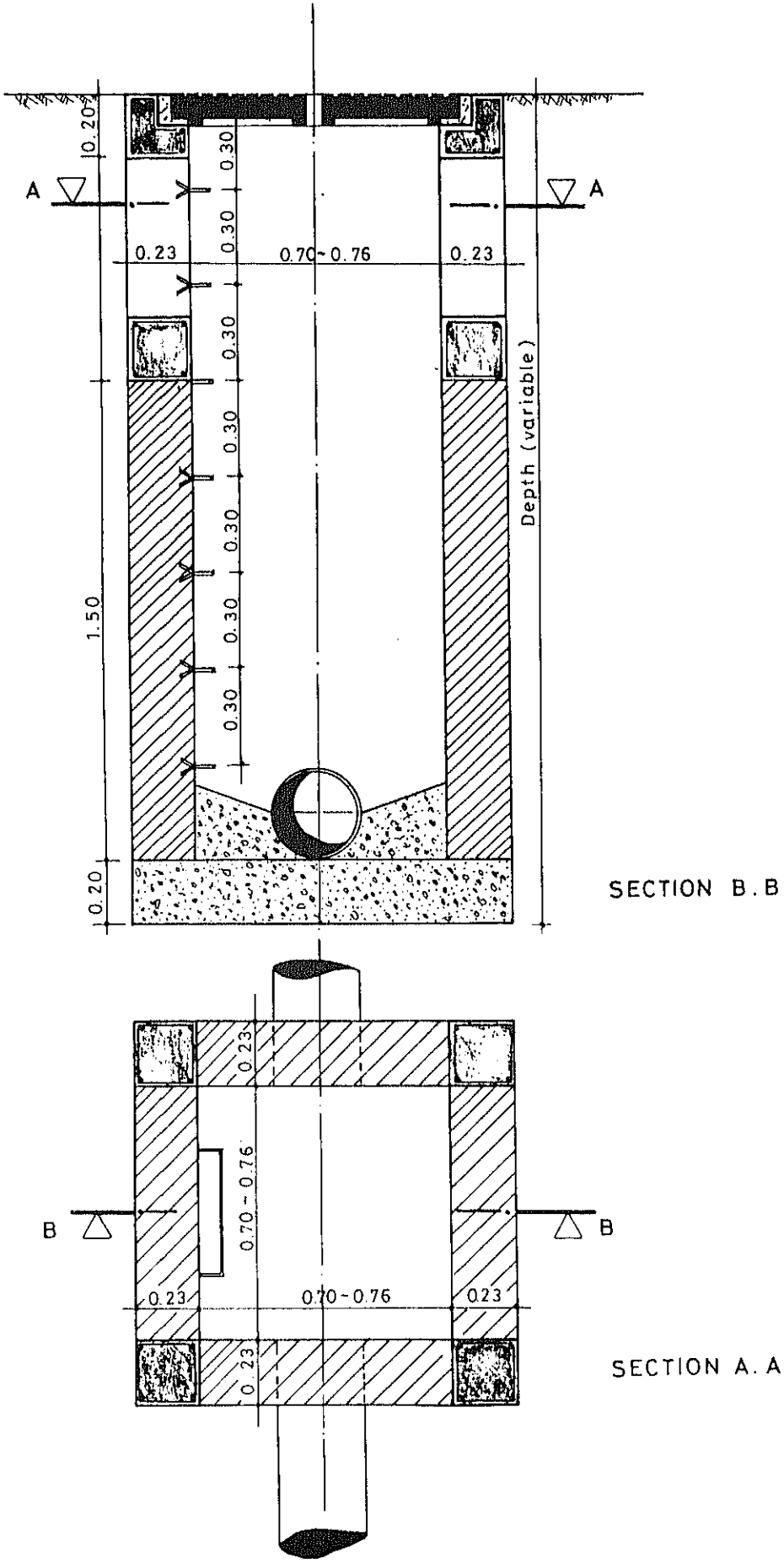
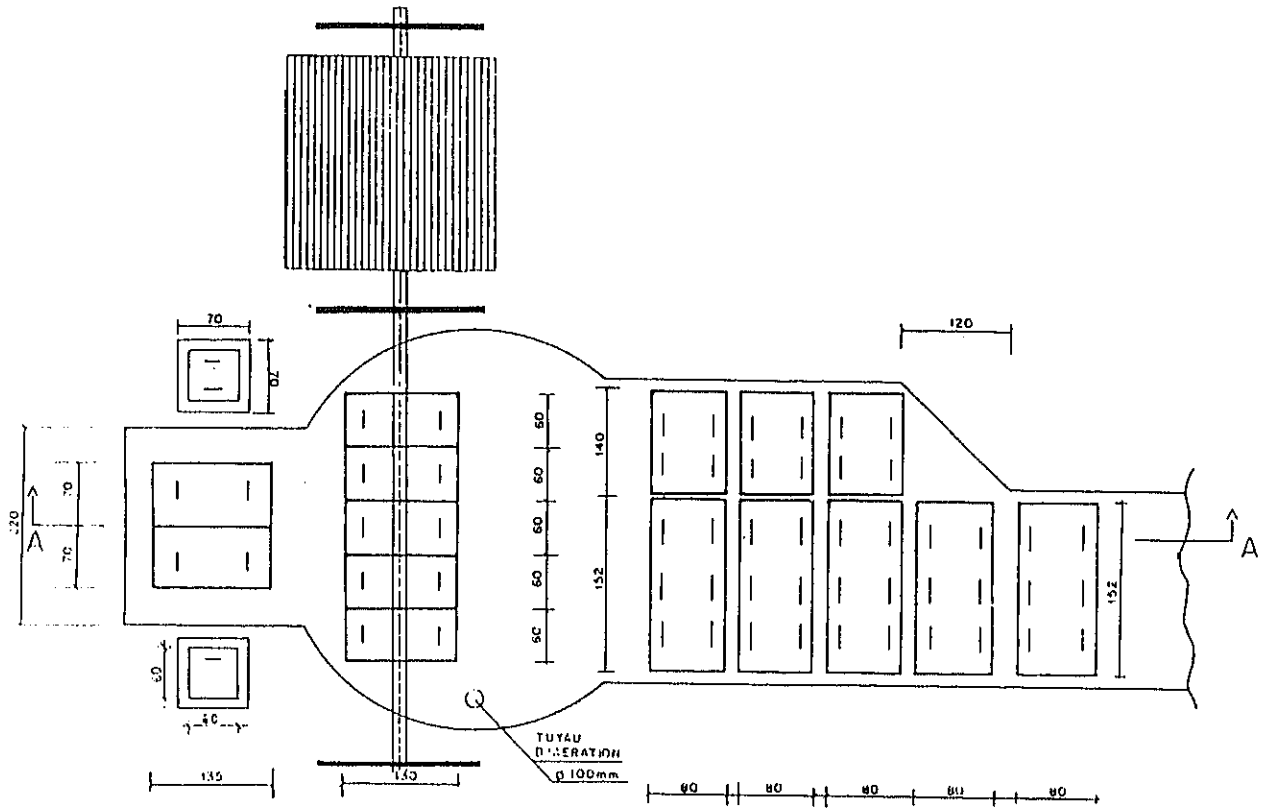
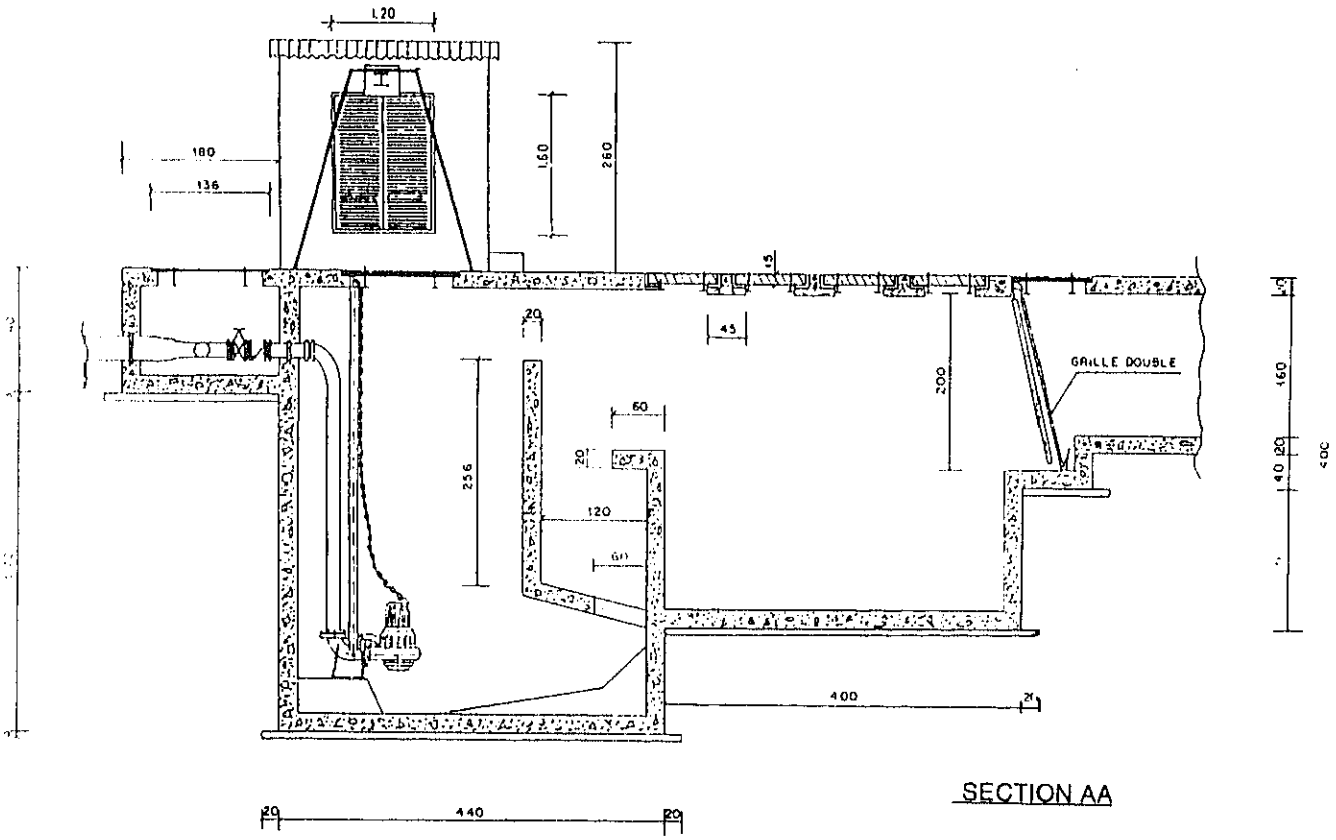



**FIGURE B.1.5 TYPICAL MANHOLE STRUCTURE (DEPTH=3.5M)**




PLAN




SECTION AA

**FIGURE B.1.6 TYPICAL STRUCTURE OF PUMPING STATION (SUBMERSIBLE TYPE)**

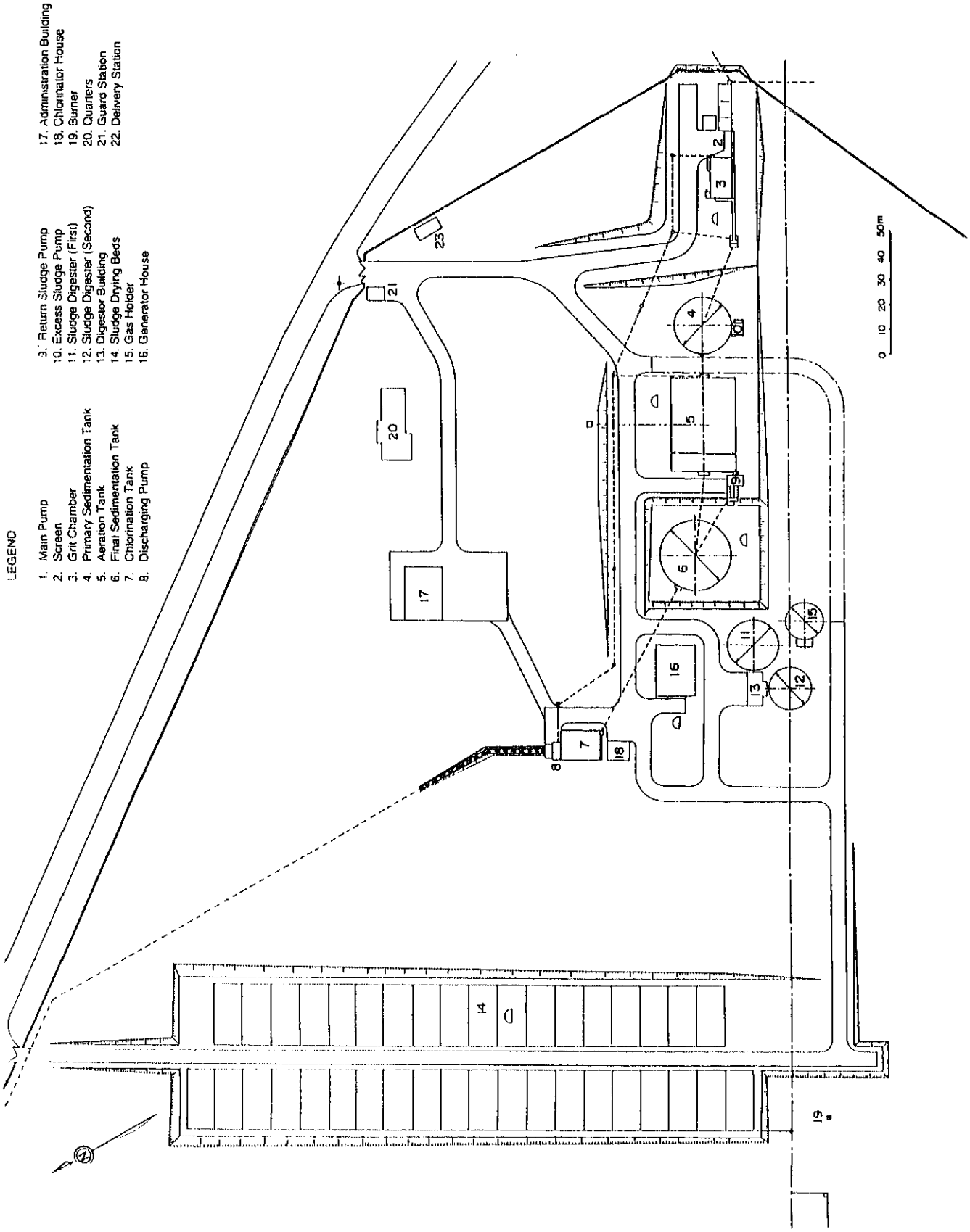



**FIGURE B.1.7 PLAN OF CAMBERENE WASTEWATER TREATMENT PLANT**

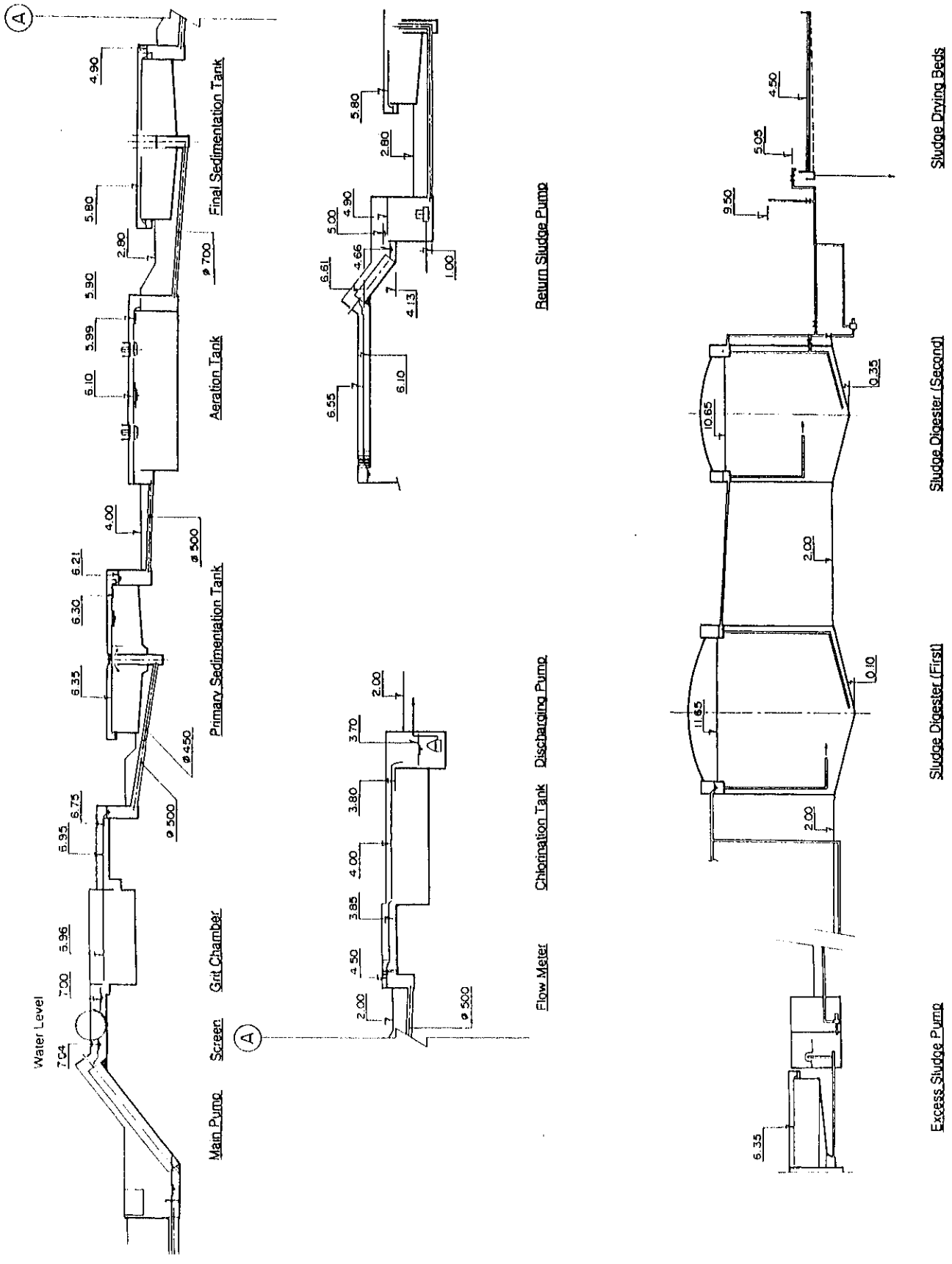



**FIGURE B.1.8 HYDRAULIC PROFILE OF CAMBERENE WASTEWATER TREATMENT PLANT**

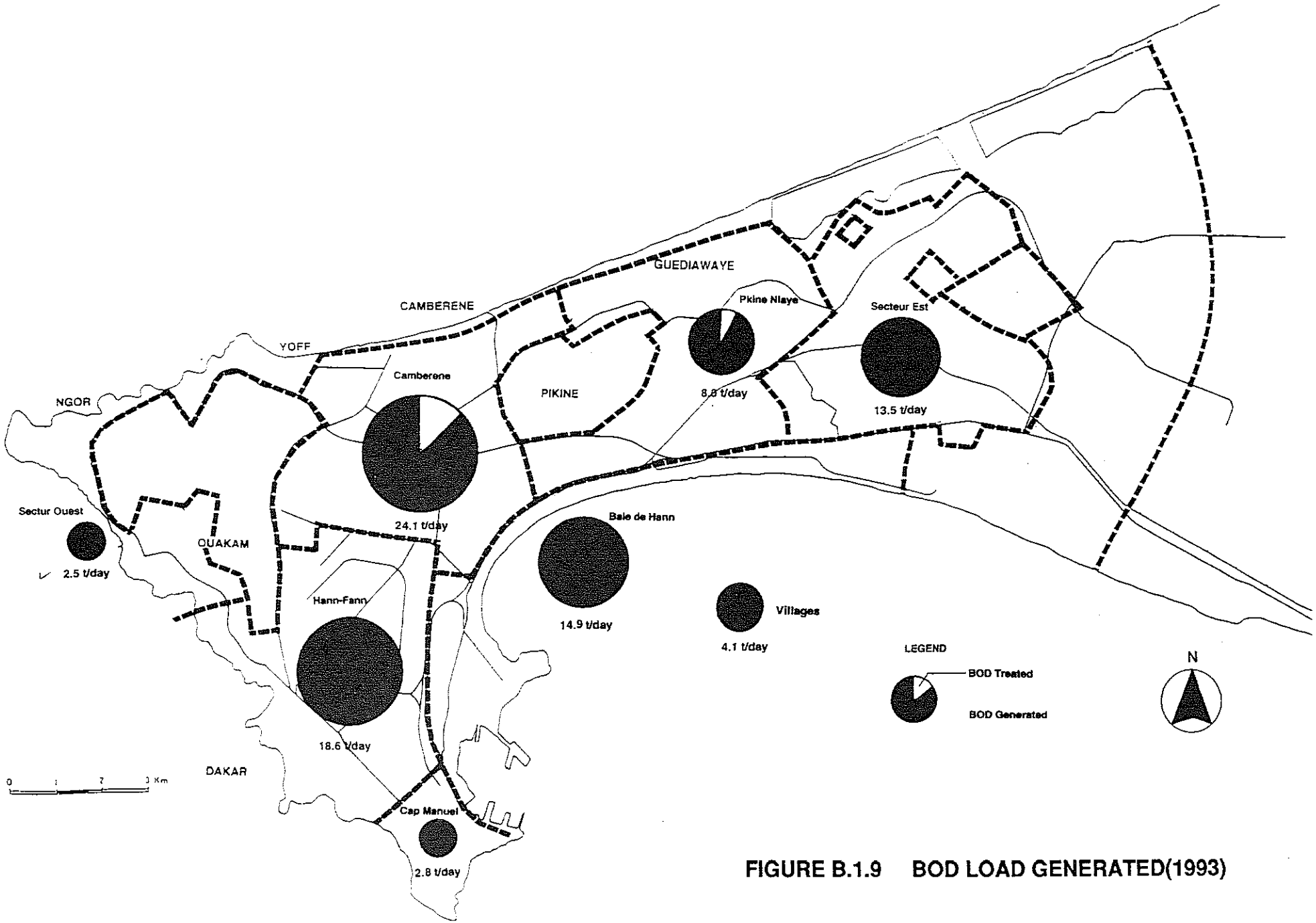



**FIGURE B.1.9 BOD LOAD GENERATED(1993)**

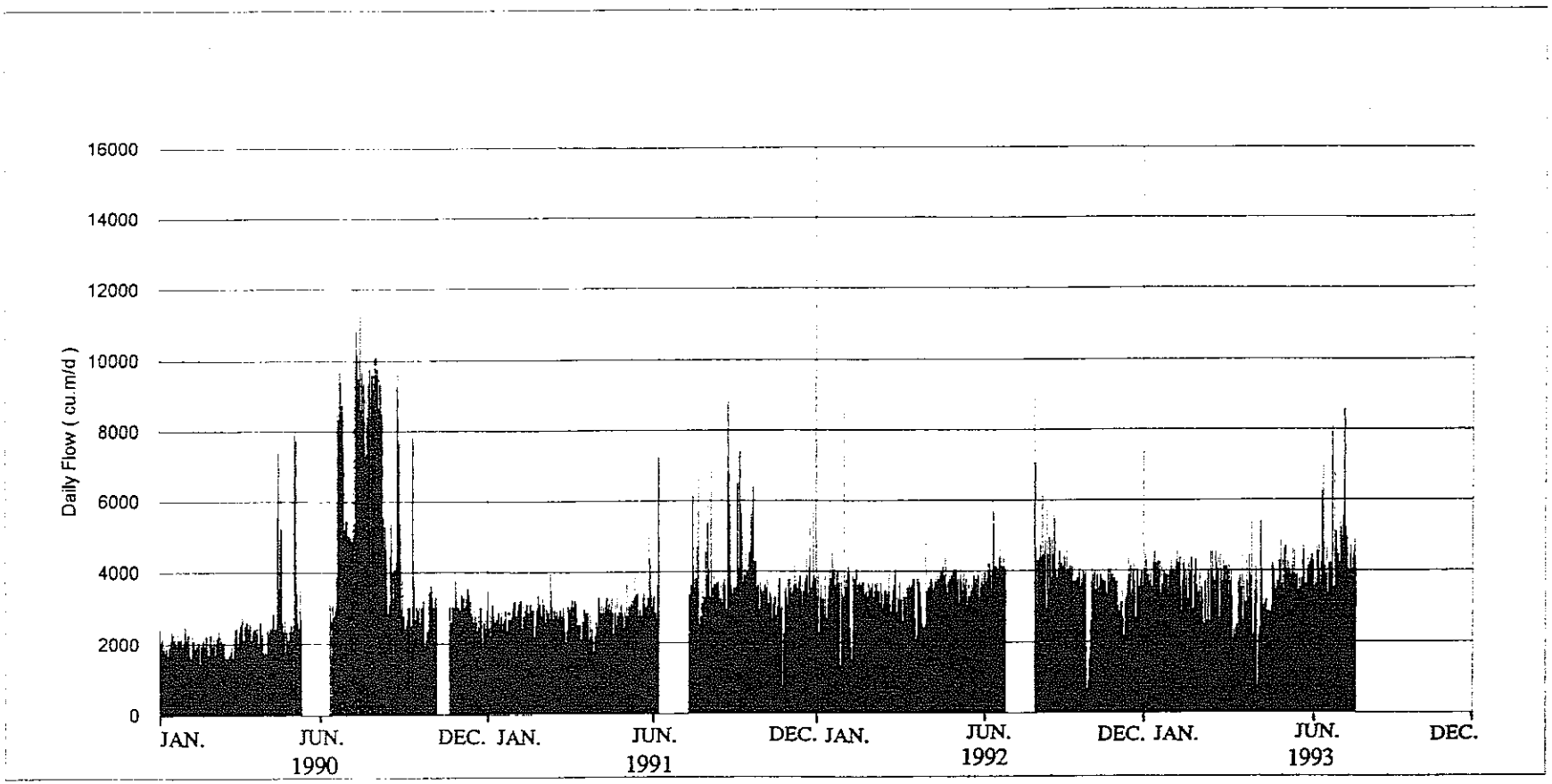



**FIGURE B.1.10 DAILY WASTEWATER FLOW TO CAMBERENE WASTEWATER TREATMENT PLANT 1990 TO 93**

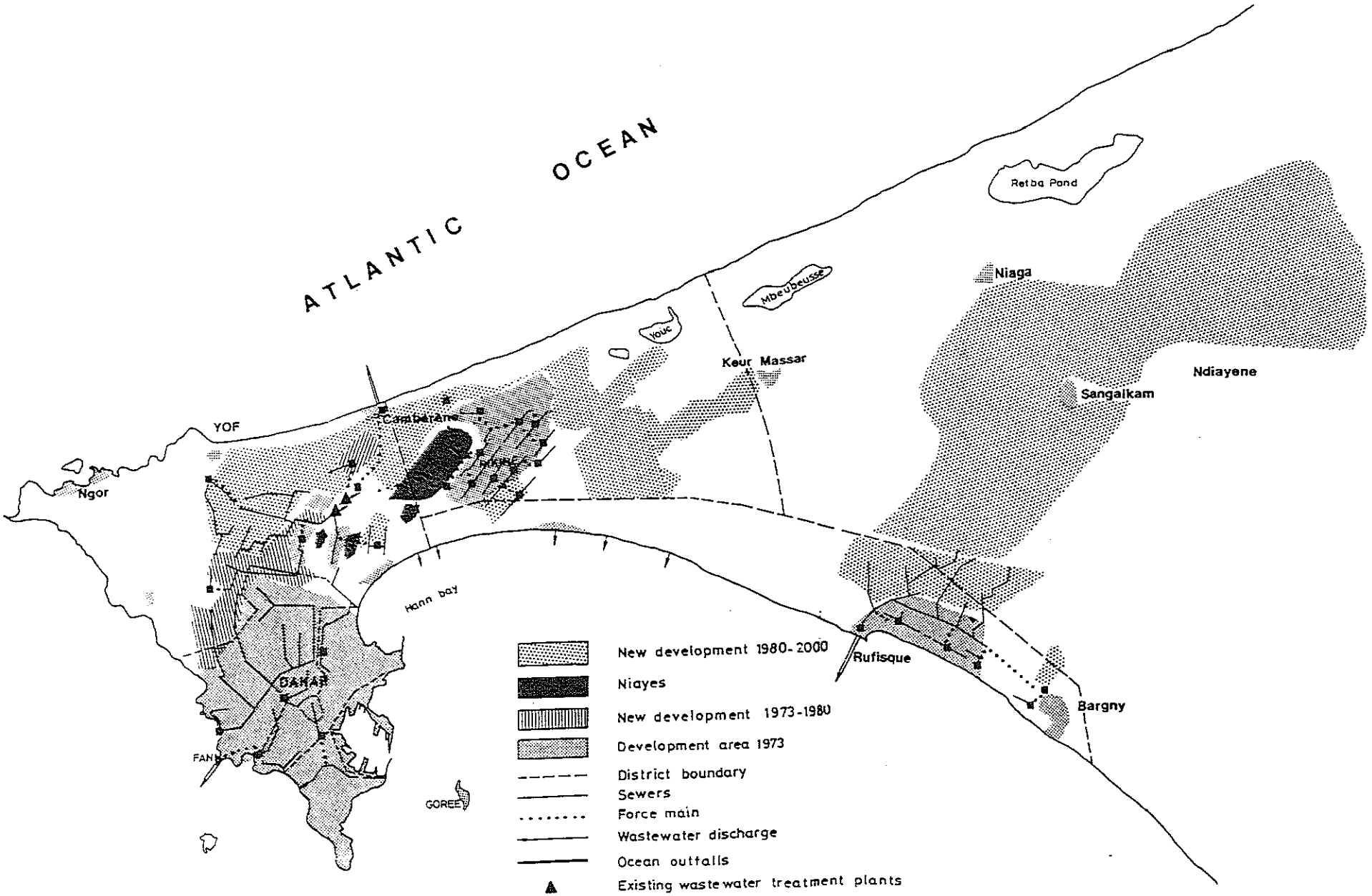



**FIGURE B.1.11 SEWERAGE SYSTEM PROPOSED BY WATER SUPPLY AND AND SEWERAGE MASTER PLAN (2000)**

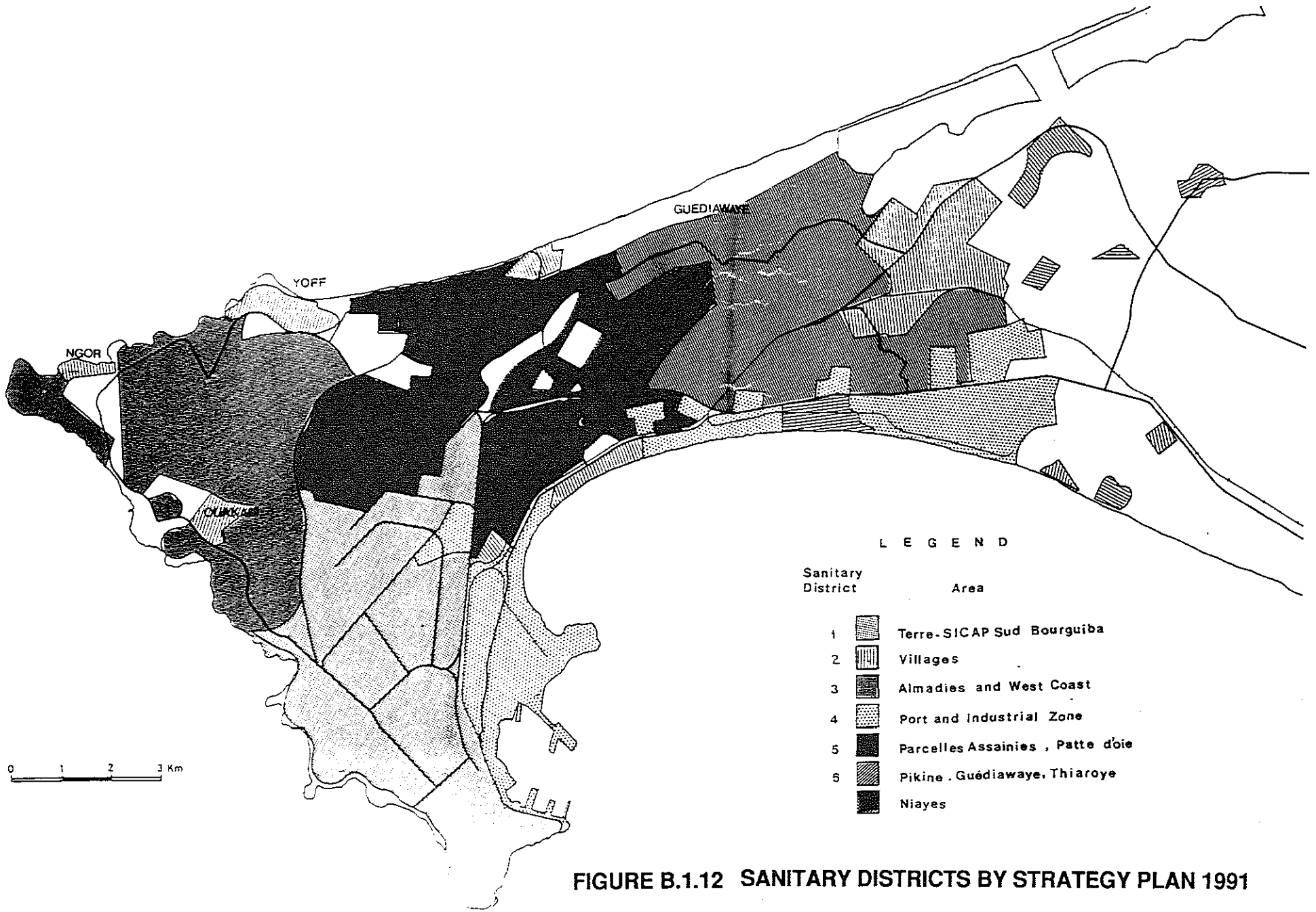
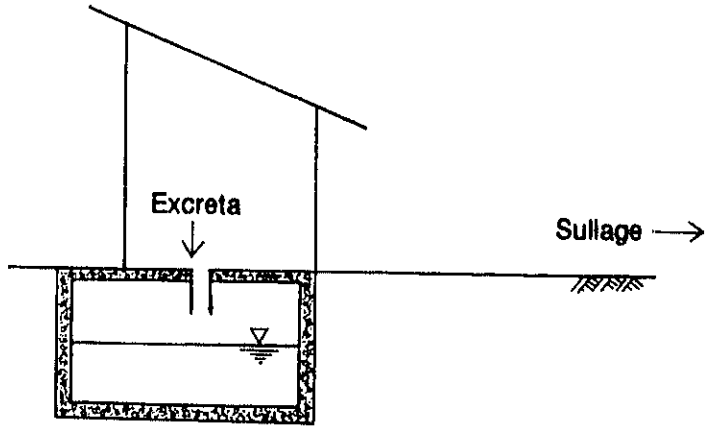
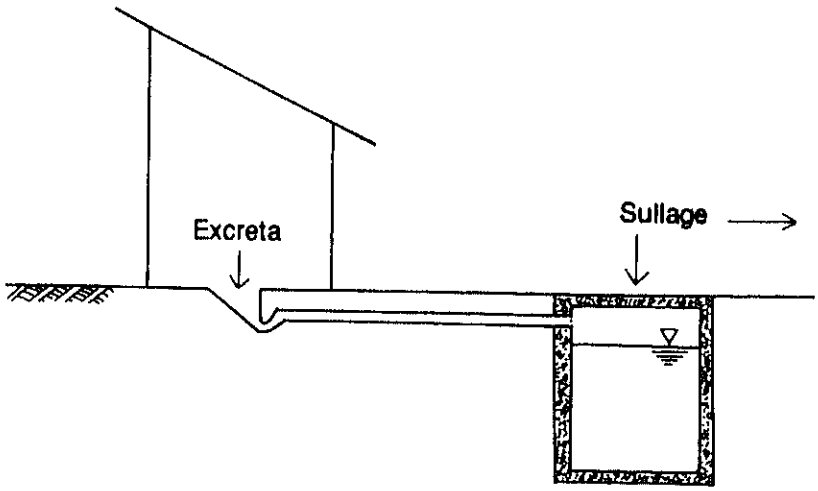


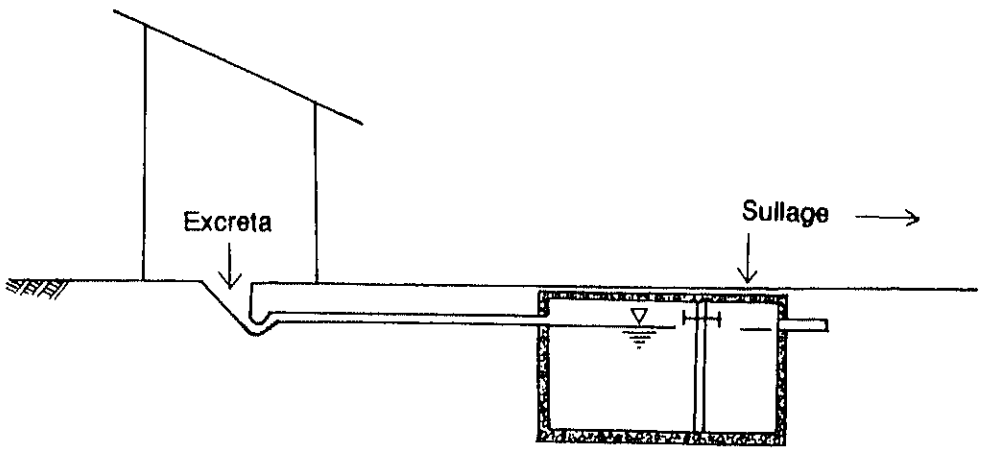

**FIGURE B.1.12 SANITARY DISTRICTS BY STRATEGY PLAN 1991**




Simple Toilet (Dry Type)




Turkish Toilet without Septic Tank (Pour Flush Type)




Turkish Toilet with Septic Tank (Pour Flush Type)

**FIGURE B.1.13 MOST COMMON TYPES OF ON-SITE SYSTEM IN THE STUDY AREA**

# CHAPTER 2 PLANNING CONDITIONS

This chapter deals with the planning fundamentals for the sewerage and sanitation systems. The planning and design basis for the component facilities have been developed and various alternative plans for possible sanitary systems have been considered so that the most appropriate system plan can be worked out for the Study Area. Following a review of appropriate technologies, the best solution for each of the units has been selected.

## 2.1 POPULATION AND LAND USE

As mentioned in Chapter 3, the population projections and the future land use worked out in the Strategy Plan are the basis for the current study, as the Plan was prepared just two years ago in 1991, and the study area is identical. However, during the course of the first on-site work, information regarding new development was obtained from various development authorities. The different plans are at different levels of development at present. Some of them have been authorized by the Ministry of Town Planning and Housing, others are at the conceptual planning stage and have yet to be authorized. For the sewerage planning, authorized plans which are expected to be realized in the near future, at the latest by 2010, are taken into account.

Ten new development areas including on-going development areas were identified and development plans were collected. For these areas, population projections made by the Strategy Plan were reviewed and modifications were made, as required.

The location of Unit 159, which is now called as the Mbao Housing Development, has been determined, which was not located on the map in the Strategy Plan, although its population was estimated to be 262,000. This huge development area is located between Reboisement de Mbao and Rufisque to the north of National Road No. 1. Because of the configuration and inclusion of the area, the boundary of the Study Area has been modified as shown in *Figure* B.2.1. Another huge housing development near Malika, which will accommodate a total of 130,000 inhabitants, has also been located. This development area which is designated as Unit 142b is called as the Malika Housing Development. The population of Unit 89 has decreased from 72,000 to 35,000, because the development plan of the area between Autoroute and Dalifore, south of the National Road No.1, and its future population were made available. The remaining seven development areas are comparatively small and minor population adjustments have been made.

A sizable development has been planned by the Senegalese Government in Grand Niaye north of the National Road No. 1, which is called "Technopole". This is kind of so called "Science Park" project, and the aim of the project is to create new economic resources by amalgamating advanced scientific knowledge and local technology. Four fields, viz. agriculture and food, information and telecommunication, management and animation, and environment, energy and medicinal plant have been focused on. Public research institutions related to the four field, such as ITA (Institut de Technologie Alimentaire), ISRA (Institut Senegalais de Recherches Argicole), and SONATEL, have participated in the project in this respect. Private enterprises which have interest in the fields are also encouraged to take part in the project.

A total of approximately 199 ha will be developed by reclaiming about a third of Ground Niaye area. Out of 199 ha, 80 ha or about 40 % of the area is allocated for various buildings including utilities. Hotel and restaurants for guests and people working in Technopole are planned, but no housing unit. The project will be implemented by two phases, i.e. 45 ha by the first phase and 35 ha the second stage. Most of the remaining 119 ha or about 60 % will be green and water.

Technopole is designated as a new unit, Unit 94b, for the planning purposes.

The location of the ten new development areas and Techonopole are shown in *Figure* B.2.1.

With the modifications mentioned above, the population in the Study Area in 2010 has changed from 2,815,459 to 2,908,871 (3.3 % increase). The projected population in each unit in the years 2000 and 2010 is tabulated in *Table* B.2.1.

The classification of land use generally follows the designation indicated in the Strategy Plan. A significant change from the Strategy Plan has been recognized for an area situated south of the Pikine railway station. Presently the area is occupied by a military camp. However, the Study Team was

informed that the military authority had already agreed to evacuate the camp, and that the area would be redeveloped as an administrative and commercial center for the Pikine district. The redevelopment plan is duly considered in the sewerage planning, though its has yet to be authorized.

In addition to the modification mentioned above, a conceptual redevelopment plan for the Pikine Irregular area was obtained. The completion of the redevelopment of the area will take a considerable period of time, and cannot be expected by 2010, taking into account the enormous area and population. However, regularizing of the land ownership and of the physical arrangement was initiated for an area in Pikine Irregular under technical assistance by GTZ, Germany, and with the inhabitants' participation. The upgrading of living conditions by the provision of water supply house connections and appropriate sanitary facilities is one of the main objectives of the redevelopment project. At present, the project area is limited to a small portion of the Pikine Irregular area, and the regularized area is further limited. However, the willingness of the inhabitants to improve the living conditions has led to the realization of the project. Therefore, the appropriate sanitation systems for the area after the completion of the redevelopment will be discussed in the current report.

The conceptual redevelopment plan is used for the sewerage system planning for the Pikine Irregular. It is therefore noted that the sewerage project can not be implemented before the redevelopment is realized, and that the sewerage plan should be modified as the actual redevelopment takes place.

A huge industrial area is designated along the Hann Bay from the Dakar Port to Mbao. This long area on the shoreline is interrupted by two traditional villages, viz. Hann Pecheurs and Tiaroye Mer. Large scale industries are concentrated in the industrial area, although there are still many undeveloped plots, especially in the eastern part. The industrial area will be developed gradually as new industries are established. Therefore, most of the industrial wastewater will be generated in the industrial area.

By 2010, the areas between Dakar and Pikine will be fully developed and urbanization will proceed further eastward to near Malika. However, there still remain some large unoccupied areas. The Dakar airport and its surrounding areas is one of them. The Grand Niaye area is also a large open space, where agricultural lands and swamps exist. However, as mentioned previously, the Technopole will be developed in the Grand Niaye which will reduce the area by approximately 200 ha. The Grand Niaye area is very important for recharging of groundwater and preservation of wildlife. In addition to the Grand Niaye, forests along the north coast and in Mbao, and small lakes near Malika are large open spaces to be preserved. The communication facilities of ASECNA and the military authority in Yeumbeul will remain comparatively large unoccupied areas.

## 2.2 SEWERED AREA AND UNSEWERED AREA

### 2.2.1 Criteria for Selection

The conventional sewerage system existing in the Study Area is not always the best solution to realize satisfactory sanitary conditions. Many constraints prohibit the application of the sewerage system, such as economic, financial, social, physical and other constraints. A conventional sewerage system does not function properly if the water consumption of the connected households is less than a certain level, e.g. 50 lpcd. It is very difficult and excessively costly to install sewer pipes in an area where road networks are disorderly, such as in the villages and in the spontaneous irregular housing areas (Types 1 and 2) in the Study Area.

The most serious constraint might be the financial and/or economic conditions of the implementing authorities and beneficiaries. This does not only refer to the availability of initial investment for construction. The project cost, necessary for both construction and operation and maintenance, is to be paid for by the beneficiaries, directly or indirectly, on a long term basis. A sewerage project implemented in an area where the beneficiaries' ability-to-pay is inadequate, will fail in the long-term, causing more serious environmental problems.

There are many technological alternatives, primarily on-site systems, to the conventional sewerage system. A series of publications prepared by the World Bank for the initiation of the International Drinking Water Supply and Sanitation Decade (1981-1990) recommend various appropriate sanitary systems for developing countries, based on the broad technical, economic, health and social findings obtained from research conducted all over the world.

Algorithms have been developed as a guide to select the most appropriate system for a project. The conditions of an area, including the constraints mentioned above, are put into the three staged algorithms as criteria for selection. Although the algorithms are directly applicable to many situations encountered in developing countries, they cannot be used blindly for a specific project or area. Criteria and appropriate sanitary systems should be selected taking into the conditions of the area.

A simplified form of the algorithm focusing on the selection of a sewerage system, which is a modification of the World Bank's algorithms, is shown in *Figure* B.2.2. Appropriate on-site systems are not specified in *Figure* B.2.2, and these are discussed in Section 2.4.7 of the current report. Social and environmental criteria, which preclude the use of conventional sewerage system, are neglected since there are no such constraints observed in the Study Area. Affordability of the sewerage project will be discussed in Chapter 3.

Availability of yard or house connections and water supply service level indicated by per-capita wastewater flow (lpcd) are the first and the second steps of the selection process, respectively. Inhabitants who do not have access to SONEES distribution networks and who use standpipes are left out from sewerage service.

Three physical characteristics, viz. population density, plot size and soil permeability, form the third, fourth and fifth steps. The first two items are closely related to the housing types. Perspectives worked out for each unit by the Strategy Plan are adopted in general, with a few exceptions, for the current study. A minimum population density of 50 persons/ha is adopted, taking into account the present population densities of the sewered units.

The Strategy Plan also identified the characteristics of the soils, and classified them into seven types based on the suitability for wastewater disposal. These are as follows:

| TYPE | SUITABILITY FOR WASTEWATER DISPOSAL |
|---|---|
| I | Not suitable unless the entire soil at the place is replaced |
| II | Suitable for treatment by infiltration if groundwater table is adequately below the surface |
| III | Suitable, but risks of groundwater pollution exist |
| III' | Suitable, groundwater is protected by basalt rocks formation |
| IV | Most suitable for treatment by infiltration |
| V | On-site system is possible by artificial means |
| VI | On-site system is impossible because of high groundwater table |

A map showing the distribution of the soil types in the Study Area attached to the Strategy Plan report is shown as Figure B.3.15 in Chapter B.3. Therefore, this classification is applied at the fifth step.

At the final step of the selection, cost comparison between the septic tank and the conventional sewerage systems is to be conducted. The selection of the systems will be discussed later.

In addition to the above, the possibility of the small bore sewer system is determined for the areas where the water supply service level is too low for the conventional sewerage system, but whose connection to a sewer network can otherwise be readily implemented. Suitable units for the small bore sewer system will be selected after the sewerage planning area is determined.

### 2.2.2 Sewerage Planning Area

All units in the urbanized area in 2010 discussed in Section 2.1 were examined according to the criteria mentioned above. Consequently, the sewerage planning area was determined as shown in *Figure* B.2.3.

Most of the traditional villages, such as Hann Pecheurs, Thiaroye Mer, Yoff, Grand Mbao, Malika, Yeumbeul and Kamb Goundao, were sifted out because of their low water consumption, disorderly road network, or remote location. On the other hand, some of the traditional villages, such as Hann, Ouakam, and Ngor were included in the sewerage planning area because of their proximity to other sewerage planning areas or soil conditions.

Two large housing development areas, viz. Malika and Mbao, were included in the sewerage planning area, since wastewater should be treated and sewerage system is considered to be the most appropriate sanitation system for the areas. Sewerage systems for the areas can not be designed to the same detail as

in case of the other planning area because of non-availability of topographic maps. The location and processes of the treatment plants are recommended, and construction costs are estimated.

A large area, Pikine and Tiaroye Irregular and its surroundings, is included in the sewerage planning area. This area is classified as spontaneous irregular area and sewerage system can not be planned if the present road networks in the area continue to exist. Therefore, sewerage system for the area is planned based on the conceptual redevelopment plan which shows new and improved road networks.

The industrial area along the seashore of the Hann Bay is included in the sewerage planning area. A sewerage system mainly for collection and treatment of the industrial wastewater is designed as one of the alternatives. Alternatives for industrial wastewater treatment, i.e. either by sewerage system or individual treatment, are discussed later in Section 3.4 of the current report.

## 2.3 WASTEWATER QUANTITIES AND POLLUTANT LOADS

All the pollutant sources in the Study Area which produce wastewater have been identified. Pollutant loads from non point sources, such as storm water runoff and agricultural drainage, are not considered because of the non-availability of basic data. Domestic wastewater quantities are calculated based on the population projections and unit wastewater flow rates. Wastewater quantities from the other sources, such as industrial, commercial, and institutional establishments are also calculated, based on the water consumption projections and wastewater characteristics. Wastewater quantities and pollutant loads for all units are calculated for the years 2000 and 2010, regardless of the availability of a sewerage system. Wastewater quantities and pollutant loads to be collected by the sewerage system are then worked out, taking into account the sewer connection rates.

### 2.3.1 Pollutant Sources

Almost all the water consumed in the Study Area is supplied by the SONEES water supply system. Groundwater is still used mainly for domestic purposes. The population who rely entirely on groundwater, however, is very small, and their wastewater flow and pollutant load are negligible from environmental and sewerage planning view points.

SONEES classifies its consumers into the following 18 categories mainly for water tariff collection purposes.

SONEES Consumer Category

| Code | Type of consumers |
|---|---|
| A | Domestic consumer, 15 mm dia. |
| L | Domestic consumer, 20 mm dia. |
| B | Commercial and Industrial |
| C | Administration, Senegal |
| D | Municipal building |
| E | Standpipe |
| F | Public toilet |
| G | Market |
| I | Religious institution, non profit |
| K | Market gardening |
| M | Religious institution, with profit |
| N | Administration, foreign |
| P | Public establishment |
| Q | Administration, foreign, without TVA |
| R | Public school |
| U | Small market gardening |
| W | Park and garden |
| T | Gardening, Beerthialane (non-treated water) |

The distinctive feature of the SONEES classification is that gardening water is classified as a separate category. These consumers are Codes K, U, W and T of the above list. The gardening demand either evaporates into the air or penetrates into the soil, and produces no wastewater. Therefore, water consumption by these categories can be neglected from the sewerage planning point of view.

Domestic consumption is classified into Codes A, L and E. In addition, Codes C, D, F, G, I, M, N, P, Q, and R are the consumption by various kinds of human activities, and therefore, the characteristics of wastewater is basically similar to domestic wastewater. These consumers are grouped into the institutional category for sewerage planning. The characteristics of the wastewater produced by a part of Code B consumer in the above list, i.e. commercial, is also similar to domestic wastewaters.

The characteristics of industrial wastewater widely vary and are quite different from those of domestic wastewaters, and depend upon the raw materials used, products produced and processes adopted. Therefore, industrial wastewater is dealt with separately in the current report.

### 2.3.2 Unit Wastewater Flow and Pollutant Load

1) Per-capita Water Consumption Rates

Per-capita water consumption widely varies in the Study Area, depending upon the economic status of the consumers, which is reflected in the types of houses, and more precisely on the number of water taps available in the house. Access to the SONEES water distribution networks affects the consumption rates. However, SONEES distribution networks have been extended to almost all the existing urbanized area. Every new housing development has provision for water supply system. Therefore, access to the distribution networks is not a serious problem in the Study Area.

One of the factors which increase the water consumption is the connection to the sewerage system. Even for houses which do not have water supply house connection, per-capita water consumption is larger if they are connected to the sewerage than those without sewer connections. This factor should be considered carefully in sewerage planning, since provision of a sewerage system increases the water consumption and wastewater quantities generated.

The Strategy Plan investigated the per-capita water consumption in each unit, and analyzed the correlation between consumption rates and housing types and access to the sewerage system. Strong correlation was observed between water consumption rates and housing types, which, in turn, suggests a strong correlation between housing type and water supply status.

Per-capita water consumption increases as the housing type changes from 1 to 6. There is an obvious correlation between the water consumption rates and access to the sewerage system.

Seasonal fluctuations were also analyzed by the Strategy Plan. It was found that the water consumption rates in rainy season were larger than those in dry season, and that the ratio of the former to the latter is greater as the per-capita consumption rate decreases.

Per-capita water consumption rates worked out by the Strategy Plan are shown in *Table* B.2.2.

Based on the analysis of the present water consumption rates in the table, the Strategy Plan used the figures in *Table* B.2.3 for sewerage system planning.

Upgrading the water supply service level by the implementation of major projects, such as the completion of the Cayor canal and relevant improvements in the distribution system, and the realization of major sewerage projects were envisaged in working out the consumption rates. Therefore, it is considered to be appropriate to use these figures for the planning of the sewerage system.

2) Commercial and Institutional Water Consumption

Per-capita water consumption rates presented in the *Table* B.2.3 include water consumption for commercial and institutional purposes, as far as these establishments are comparatively small and included in the residential areas and not identified separately as a unit. Large scale commercial and institutional establishments, such as resort hotel complexes, military camps, the university, and schools, are identified as separate units, and their water consumptions are calculated separately on a basis of their population equivalence. Therefore, commercial and institutional water consumption is estimated either as a part of domestic water consumption or separately.

3) Industrial Water Consumption

The results of the questionnaire survey for selected factories are used to work out the industrial water consumption rate per area (ha). Among 24 factories responding to the questionnaire, both the plot area and water consumption were available for 15 factories. The average water consumption rate per plot area is calculated to be 62 $m^3$/ha/day as shown in *Table* B.2.4. Then, the actual area occupied by factories as a percentage of the industrial area was investigated, selecting a representative fully developed industrial area along Canal IV. This percentage works out to be 58 %. Therefore, the industrial water consumption was calculated as follows.

Industrial Water Consumption: $62 \times 0.58 = 36.0$ $m^3$/ha/day

This unit industrial water consumption rate is used uniformly to estimate the future industrial water consumption. Industrial areas designated at present have not been fully occupied and open spaces are still available. It is assumed that the designated industrial area will be developed fully by 2010 in estimating the industrial water consumption.

4) Pollutant Load

The current per capita pollutant load (BOD) was worked out to be 47 gpcd as mentioned in Section 1.2.3. Per capita BOD load in various parts of the world including industrialized and developing countries vary between 23 to 78 gpcd. Compared with this, per capita BOD load of 47 gcpd is considered to be very normal for the urban area like Dakar.

For planning purposes, an increase in per capita load should be considered since the per capita load increases as per capita water consumption increases. In the Strategy Plan, a per capita BOD load of 60 gpcd was used for the estimation of the future pollutant load as well as for the design of the treatment plants. If this 60 gpcd is used for the year 2010, it means an annual average increment of 0.76 gcpd. This magnitude of increase is considered to be reasonable taking into account the increase of the per capita water consumption. Thus, the per capita BOD load in 2010 is determined to be 60 gpcd.

Other parameters, viz. SS and COD, are determined in proportion to the BOD load. The ratios obtained from the results of the water quality analysis of the raw sewage at Camberene WWTP were used. Per capita pollutant load for BOD, SS and COD is determined to be as follows.

| Parameter | 1993 | 2000 | 2010 |
|---|---|---|---|
| BOD (gpcd) | 47 | 52 | 60 |
| SS (gpcd) | 51 | 57 | 65 |
| COD (gpcd) | 89 | 99 | 114 |

It is expected that new factories will be established in the industrial area along the Hann Bay. The type of new industries cannot be known at present. However, it can be reasonably assumed that factories which consume large quantity of water and produce strong wastewater, such as organic chemical and pulp and paper factories, will not be established in the near future, and that types of the new factories do not differ significantly from those that exist at present. Therefore, the average concentration figures shown below obtained from the analysis is used for all industrial wastewater.

Characteristics of Industrial Wastewater

| Parameter | Concentration |
|---|---|
| BOD | 910 mg/l |
| SS | 1,010 mg/l |

A slaughter house located in Pikine discharges very strong wastewater, i.e. BOD 6,000 mg/l. Pollutant load generated by the slaughter house is estimated separately using the obtained BOD concentration.

### 2.3.3 Projection of Wastewater Flow and Pollutant Loads

Wastewater flow projection for the entire Study Area is tabulated in *Table* B.2.5. Domestic wastewater flow is estimated to increase from 168,074 $m^3$/day in 1993 to 495,422 $m^3$/day in 2010, i.e. 195 % increase. Overall per capita wastewater flow rate, which is 102 lpcd in 1993, will increase to 163 lpcd

in 2010. Industrial wastewater flow will also increase from 12,914 $m^3$/day in 1993 to 28,220 $m^3$/day in 2010, i.e. 119 % increase. Total wastewater flow will increase from 180,988 $m^3$/day to 523,642$m^3$/day.

The pollutant load in terms of BOD generated in each unit is tabulated in *Table* B.2.6. The total BOD load generated will increase from 88.6 t/day in 1993 to 207.6 t/day in 2010, i.e. 134 % increase. Out of the total BOD load of 207.6 t/day, 181.9 t/day or 88 % is domestic in origin, and the remaining 25.7 t/day or 12 % of the total is industrial in origin.

## 2.4 SYSTEM CONSIDERATIONS

### 2.4.1 Wastewater Flow Ratios

A part of the water demand is not returning to the sewerage system or other sanitary systems. Garden sprinkling and car washing water evaporates or flows into the drainage system. A part of the water consumed by humans evaporate from human bodies, although it is very small in quantity. Therefore, in order to estimate the wastewater flow from the water consumption, a certain ratio is usually adopted. The Strategy Plan used the following ratios, based on the analysis of the use of water and disposal practices. The type of housing has more significant effects on the ratio. Provision of a sewerage system also increases the ratio.

The same ratios are used for the current study.

| Category | Wastewater Discharge Ratio |
|---|---|
| Housing Type 1 | 0.85 |
| Housing Type 2 | 0.85 |
| Housing Type 3 | 0.75, 0.80 or 0.85 |
| Housing Type 4 | 0.75, 0.80 or 0.85 |
| Housing Type 5 | 0.75 or 0.85 |
| Housing Type 6 | 0.85 |
| Industry | 0.80 |
| Port | 0.80 |
| Airport | 0.25 |
| Others | 0.75 or 0.80 |

### 2.4.2 Infiltration

Although the proposed sewer joints are water-tight types which will reduce the quantity of unwanted groundwater infiltration into the sewers, sewer design must make an allowance for such non-waste components which inevitably become a part of the total flow. The groundwater elevations in the existing sewerage service areas are generally lower than the sewers, and no serious infiltration has occurred until now. However, groundwater elevations in Pikine and the Niaye areas in the Study Area are generally high. Groundwater infiltration should be taken into account in designing sewer networks for these areas.

Since no data is available in the existing sewerage system for the infiltration rates, an effort was made to work out the infiltration rate. A study conducted in the United States reported the infiltration rates to sewers which are laid below the groundwater table are as follows.

| Sewer Dia. | Infiltration | |
|---|---|---|
| | ($m^3$/day/km) | ($m^3$/day/cm dia./km) |
| 200 mm | 8.3 - 11.6 | 0.42 - 0.58 |
| 300 mm | 10.4 - 13.9 | 0.35 - 0.48 |
| 600 mm | 23.3 - 27.8 | 0.39 - 0.46 |

Average branch and lateral sewer (diameter less than 250 mm) length per area was worked out to be 289 m/ha in a case study for a part of Parcelles Assainies. The average length of primary and secondary trunk sewers (diameter more than 300 mm) worked out in the Strategy Plan was 111 m/ha.

If it is assumed that half the branch and lateral sewers and all the secondary and primary trunk sewers are laid below the groundwater table, and their infiltration rates are taken as 10 and 20 $m^3$/day/km respectively, the average groundwater infiltration rate is calculated as follows.

| | | |
|---|---|---|
| 10 x 0.289 x 0.5 | = 1.45 | |
| 20 x 0.111 x | = 2.22 | |
| Total | 3.67 | ($m^3$/day/ha) |

Thus, figure of 4.0 $m^3$/day/ha is worked out and used for the design of the sewers in the area where the groundwater table is shallower than 4.0 m from the surface of the ground. Areas where groundwater infiltration is considered is shown in *Figure* B.2.4.

### 2.4.3 Peak Flow

In general, there are two flow rates for the design of any sewerage facility, the peak flow and the daily average flow. The peak flow is the absolute maximum flow rate anticipated for the facilities regardless of its duration. The peak flow is, therefore, used for the design of sewer pipes, pump units and pipes and conduits in the treatment plants.

In order to work out the peak flow based on the daily average flow, round-the-clock flow rates measured at the Camberene WWTP at two- hour intervals were examined. These are shown in *Table* B.2.7 and *Figure* B.2.5. The ratio of the peak flow to the average flow was found to be 1.92 at 10:00 am. Thus, the peak flow was determined to be two times the daily average flow.

### 2.4.4 Conventional Sewerage System

The conventional gravity sewer system is one of the most reliable sewerage systems, and much experience is available in planning, design, construction, and operation and maintenance, and is most widely applied system throughout the world, but in general, it is most expensive among the possible alternative systems available for safe disposal of wastewater.

Though detailed cost comparison between the small-bore and conventional sewers has not been made, a study undertaken by the World Bank indicates that the costs of conventional and small-bore sewerage systems planned for a 73 ha district serving a population of 39,420 were in the ratio of 1,581 to 1,013, or that the small-bore system costs roughly 60 % of the conventional system. The major costs of the conventional sewer facilities are the street laterals and manholes, which are sized to facilitate entry of solids cleaning equipment and therefore larger than peak flows would require.

The submains are designed to accommodate peak flow factors of 2, which means that they are designed to accommodate peak flows that are two times greater than average flows. The overall length of pipes between houses and street laterals are somewhat longer in the conventional sewer system than small-bore sewers.

The conventional sewer system has many merits. Firstly, it provides the greatest user convenience of all waste disposal systems, since it permits the discharge of a large amount of water. Secondly, it does not pose any risks to health when functioning properly. Maintenance is assumed by the municipality. Thirdly, it generally operates with few service interruptions or emergencies.

Yet this system also has some disadvantages. It is, first of all, expensive to construct. It requires skilled contractors for construction, a municipal organization for operation and maintenance, and a substantial amount of flushing water, which adds to the operating costs.

Given the high convenience level of the conventional sewerage system and considering the present situation of the area, where the conventional sewerage system has a long history and operated by SONEES for a few decades without any serious problems, this system is the most appropriate system.

### 2.4.5 Small-bore Sewer System

The small-bore sewer system, which carries settled effluent only, is one possibility for a less expensive sewerage system. The system is designed to receive only the liquid portion of household wastewater for off-site treatment and disposal. Grit, grease and other troublesome solids which might cause obstruction

in the sewers are separated from the wastewater flow in interceptor tanks installed upstream of every connection to the sewers, and the solids which accumulate in the tanks are removed periodically for safe disposal.

The system may have the following advantages:

- Reduced water requirements because of the settled effluent and less need for solids transportation. Thus reducing the water consumption for this purpose.

- Reduced excavation cost, with low flow velocity for self-cleansing, and possibilities of pipe laying with curvilinear alignment, with a variable or inflective gradient.

- Reduced material costs. Because of lowered peak flows by some surge storage of the wastewater in the interceptor tanks, the sewer and pumping equipment could be reduced in size. In addition, expensive manholes can be replaced with much less costly cleanouts or flushing points, thus reducing operation and maintenance cost.

- Reduced treatment requirements. Preliminary and primary treatment facilities could be excluded in the treatment works.

On the other hand, there may be some disadvantages, including:

- Clogging of sewers by sand and other solids entered the pipes. It is difficult to avoid solid materials from entering the pipes through manholes or inspection chambers. More frequent clearing is required to properly maintain function of these facilities.

- Removal of sludge from the interceptor tanks. Accumulated sludge should be removed periodically and disposed of safely. This will require additional initial and recurrent costs.

Considering the advantages and disadvantages mentioned above, and the conditions of the Study Area, a small-bore sewer system can be applied to only a limited number of areas. A few factors should be considered for the selection of suitable areas for the small-bore sewer system. Firstly, there are areas whose water consumption is inadequate for the conventional sewerage system, i.e. less than 50 lpcd. Secondly, there should be sufficient space in plots for construction of interceptor tanks. Thirdly, the sewerage networks are available in the vicinity of the area, and small-bore sewers can be readily connected to them.

### 2.4.6 Wastewater Treatment and Disposal System

As described previously sea water at many locations near the various discharging points, such as ocean outfalls of the sewer networks and outlets of drains, have been reported to be polluted. The pollution caused by the discharging of raw sewage will no doubt become more serious unless treatment is provided since the quantity of wastewater will significantly increase as the sewerage system spreads.

If the reuse of wastewater, which is desirable in such a climate as of the Study Area, is considered, some kinds of treatment is indispensable from the public health point of view. At least secondary treatment processes are required for reuse of treated effluent.

The need for appropriate treatment of wastewater is obvious to protect public health and the environment, but the degree of treatment required may vary depending on the local conditions. For wastewater treatment planning, there are essentially two major alternatives, viz. 1) discharge to the sea with a level of treatment as needed to supplement the purifying capacity of the water body, and 2) discharge to the sea or reuse of the effluent after high level of treatment (secondary process).

At present, over 50,000 $m^3$/day of raw sewage is discharged to the sea from the ocean outfalls located at Pointe de Fann and along the Madeleines coast. The pollutant discharged to the sea is carried away southward most of the year by the dominant currents in the sea, and it does not seem to seriously affect the sea and the coast in the vicinity, although the level of the sea water pollution is not known. However, in July and August, the dominant sea current changes direction and the pollutant is carried away northward. This may cause pollution of beaches for swimming along the west coast of the Cap

Vert peninsula. In addition, there is the environmentally important Madeleines Island 4 km off the coast from the Pointe de Fann.

It is reported that the pollution of the Hann Bay has been progressing to the extent that the fish catch in the bay is affected. The cause of the pollution in the bay is obviously the industrial and domestic wastewater discharged through open channels and closed pipes along the bay.

As estimated in the previous section, the quantity of wastewater and the pollutant load will increase significantly in the future. Pollution of beaches along the west coast and the Hann Bay, and of the sea water will no doubt become serious if no treatment of wastewater is performed.

Water quality standards for the natural water body including sea water and for various effluents have yet to be established. However, these are under consideration currently by the Government of Senegal. It is anticipated that effluent standards for sewerage system will be determined, based on those obtainable by the secondary treatment processes.

Under the circumstances mentioned above, treatment of wastewater is considered indispensable for the large urban community such as Dakar, and even in case of disposal to the sea, treatment should be based on biological processes. Therefore, in the sewerage planning for the Study Area, biological secondary wastewater treatment is considered.

### 2.4.7 On-site System

As explained in Section 2.2.1, areas to be covered by a conventional sewerage system will be selected by considering such constraints as economic, financial, social, technical and other constraints, and some areas would remain not to be sewered. In such areas, wastewater generated in each house has to be treated or disposed individually by on-site system.

There are several types of on-site system that would be applicable to the study area. *Table* B.2.8 explains on-site system classified by treatment methods and disposal methods. Non-treatment means that system does not have any treatment process before disposal of wastewater. Most of the present on-site system in the area is considered to be this type. In a septic tank treatment, wastewater is separated to effluent and sediment. The effluent is discharged from the tank and the sediment is stored in the tank under aerobic condition to be decomposed. Some of on-site system in the area have a septic tank. Aerobic biological treatment is a method that employs similar treatment process to that of sewage treatment in a conventional sewerage system. No on-site system with aerobic biological treatment exists in the area.

Appropriate treatment type depends on the required water quality of the treated water and type of the final disposal. If the disposal is to discharge treated water to surface water, aerobic biological treatment would be preferable not to cause water pollution problems of the surface water. If the infiltration is applicable, the septic tank would be acceptable, because further progress of purification can be expected during the process of the infiltration even though effluent of the septic tank has not been treated sufficiently. In addition, even non-treatment would be acceptable in case of the infiltration, if it is not in the densed area.

However, in the study area where the groundwater contamination by the nitrate nitrogen is significant, special consideration should be concentrated to the disposal methods rather than to the treatment methods. As mentioned in Chapter A.2, infiltration of the wastewater from on-site system is suspected as a major cause of nitrate contamination of the groundwater. Since there is no practical methods to reduce the nitrate concentrations in the wastewater applicable to the on-site system, the most practical method to mitigate the nitrate contamination of the groundwater is to reduce the wastewater infiltration. In this consideration, collection of the toilet waste by periodical withdrawal from storage pits in the on-site system and transferring it by tankers seems only way to reduce the infiltration. Even if the existing system is changed to discharge the effluent to the surface of the ground from infiltration, the effluent may easily penetrate into the ground before reaching to any water body.

Therefore, appropriate on-site system will be selected according to the flow chart shown in *Figure* B.2.6 mainly considering the above mentioned matters.

## 2.5 DESIGN CRITERIA

In general, except for special reasons, the sewerage facilities are planned and designed on the basis of the following design criteria.

### 2.5.1 Sewers

For determining sewer capacities, the Manning equation is used for pipes and conduits, flowing full or partially full to accommodate the peak flows, with 'n' values 0.012 to 0.015, depending upon the pipe material.

A minimum size of 200 mm is adopted for sanitary sewers, but for house connection pipes, 150 or 160 mm can be used. All sanitary sewers are designed to maintain a mean flow velocity, when flowing full or half full, of not less than 60 cm/sec for clay and PVC pipes, based on the Manning equation, using an 'n' values of 0.013 and 0.012 respectively. For RCP or any cement-bonded pipe material, for an 'n' value of 0.013, a minimum flow velocity of 75 cm/sec is used to avoid a risk of corrosion caused by hydrogen-sulfide.

Minimum sewer slopes for different sewer pipe sized are adopted so that the velocity of flow will be not less than 75 cm/sec for cement-bonded pipes, and 60 cm/sec for clay and PVC pipes.

All sewers are designed not to exceed a flow velocity of 3.0 m/sec to protect against sewer erosion. Where the ground slope is steep and a velocity of more than 3.0 m/sec may result, special provision is to be made to protect against displacement by erosion and shock.

For sanitary sewer design, the full capacity of the design peak flow rate is provided. When smaller sewers join a larger sewer, the crown of both sewers are to be placed at the same elevation.

Earth covering of sewer pipe is not to be less than 1.0 m unless special protective measures against the expected loads are provided.

All sewers are designed to flow, at all times, with sufficient velocity to prevent the settlement of solid matter and consequent sulfide generation, but no other measures are considered such as air injection to sewer. Where found necessary to protect cement-bonded sewers from sulfide build-up, lining may be considered.

### 2.5.2 Pumping Stations

The designs of the pumping stations of the recent construction in the Study Area have been reviewed. The present design practice adopted by SONEES is generally satisfactory. The following is the general design criteria for pumping stations.

The design of pumping stations is based on the peak flow rate. All piping and conduits are designed to carry the expected peak flow rate. Two types of pumping stations are used, viz. submersible types for small capacities and dry pit types for larger capacities. Submersible pumps are installed in the submersible type pumping stations, and centrifugal pumps with vertical axis are installed in the dry pit type. In general, if the peak flow rate is less than 50 l/sec, a submersible type pumping station is planned.

Substructures of a submersible pumping station are generally designed to be circular, and those of a dry pit type to be rectangular. Enough storage capacity, ranging from 3 minutes to 10 minutes of the peak flow rate, is provided in wet wells, where automatic controls and variable speed drives are not furnished to match pumping rates exactly with inflow rates. For all stations, provision is made to facilitate removing pumps and motors. Structures are designed for the ultimate size, but pumps, accessory mechanical equipment, and electric facilities will be purchased and installed according to the stage of construction.

Pumps are electric motor driven, but provision of emergency power supply by diesel engines is considered to insure a continually available internal power source for operation of a minimum number of pumps, instrumentation and auxiliaries.

Screening devices are generally provided ahead of pumping to remove solid materials. Where screening is provided, screenings removed from wastewater are to be disposed of by transportation to appropriate disposal sites, with local storage containers used as needed.

### 2.5.3 Wastewater Treatment Plants (WWTPs)

Various kinds of biological secondary treatment processes have been developed and applied for wastewater treatment. Among them, three treatment processes were selected for evaluation, viz. the conventional activated sludge, oxidation ditch and the oxidation pond processes.

The conventional activated sludge process was evaluated because the existing Camberene WWTP was designed and constructed based on the process and it is the most representative secondary treatment process widely used all over the world.

The oxidation ditch process is another representative secondary process applied in many countries. This process is said to be less expensive for construction than the activated sludge process when the wastewater flow is comparatively small. Operation and maintenance of the process is also easier than the activated sludge process. Therefore, the oxidation ditch process is applied for the small capacity treatment plant.

The energy consumption of the oxidation pond process is the least among all the secondary treatment processes. The process utilizes solar energy alone to degrade and reduce the organic compounds. The construction costs for the oxidation pond system is also less than any other secondary treatment system because of the minimum mechanical and electrical equipment required, and the fact that the pond is generally constructed with earth banks. However, the most serious disadvantage of the system is its requirement of huge area. For the effective utilization of the solar energy, the pond cannot be deep, e.g. shallower than 2 m for the facultative pond.

Three biological secondary processes were designed and their suitability for adoption and construction costs were compared in Section 3.3. The design criteria for the component facilities are those generally adopted worldwide.

# TABLE B.2.1 (1) POPULATION PROJECTION (1)

(unit : person) (1/3)

| No. | Unit Name | Area(ha) | H. Type | 1993 | 2000 | 2010 |
|---|---|---|---|---|---|---|
| 75 | Plateau | 388.8 | 6 | 54,321 | 79,982 | 116,640 |
| 75 b | Hopitaux (PP et Dantec) | 13.6 | | 0 | 0 | 0 |
| | sub-total | 402.4 | 6 | 54,321 | 79,982 | 116,640 |
| 46 | Equipements (CTO-CAEDA) | 12.0 | | 0 | 0 | 0 |
| 46 b | Zone de Captage | 24.4 | | 0 | 0 | 0 |
| 47 | Gendarmerie Front de Terre | 16.4 | | 0 | 0 | 0 |
| 48 | Cite Front de Terre Milli. | 6.4 | | 1,226 | 1,580 | 2,086 |
| 49 | Equipements Sportifs | 4.0 | | 0 | 0 | 0 |
| 50 | SODIDA & Zone Artisanale | 47.2 | | 0 | 0 | 0 |
| 50 b | Zone Industrielle | 21.2 | | 0 | 0 | 0 |
| 52 | SICAP | 435.6 | 4 | 125,888 | 144,184 | 170,320 |
| 24 | Cite SOTRAC-Mermoz | 12.0 | 5 | 1,439 | 1,815 | 2,352 |
| 25 | Fenetre Mermoz | 14.4 | 5 | 2,096 | 2,739 | 3,658 |
| 26 | Services Tech. SOTRAC | 18.4 | | 0 | 0 | 0 |
| 27 | Equipements Scolaires | 13.6 | | 0 | 0 | 0 |
| 28 | Mermoz-Fann | 20.0 | 5 | 3,180 | 4,020 | 5,220 |
| 29 | Terrain Militaire | 17.6 | | 0 | 0 | 0 |
| 30 | Zone Equipements | 7.2 | | 0 | 0 | 0 |
| 51 | H.L.M. Nimzatt | 89.2 | 4 | 37,379 | 40,976 | 46,116 |
| 51 b | Cite Douanes | 12.0 | 4 | 2,545 | 3,429 | 4,692 |
| 52 b | Grand Dakar | 76.0 | 3 | 25,536 | 30,324 | 37,164 |
| 52 t | Grand Dakar Usine | 40.0 | 3 | 13,440 | 15,960 | 19,560 |
| 53 | Zone Equip. Cerf Volant | 69.2 | | 0 | 0 | 0 |
| 53 b | Ouagou Niaye | 20.8 | 4 | 6,146 | 7,255 | 8,840 |
| 53 t | BOPP | 13.6 | 4 | 3,930 | 4,502 | 5,318 |
| 54 | H.L.M. Fass Ancien | 3.6 | 4 | 1,509 | 1,654 | 1,861 |
| 55 | Fass | 14.6 | 3 | 4,633 | 5,076 | 5,709 |
| 55 b | Zone A et B | 20.0 | 4 | 5,537 | 6,477 | 7,820 |
| 56 | H.L.M. Fass Paillotes | 7.6 | 4 | 2,104 | 2,462 | 2,972 |
| 57 | Fass Delorme | 34.8 | 4 | 10,057 | 11,519 | 13,607 |
| 58 | Marche de Fass | 4.0 | | 0 | 0 | 0 |
| 59 | Point E | 76.0 | 5 | 9,294 | 11,726 | 15,200 |
| 59 b | Lycee | 1.6 | | 0 | 0 | 0 |
| 60 | Ecole de Police | 9.6 | | 0 | 0 | 0 |
| 61 | SICAP Mermoz | 26.4 | 4 | 7,630 | 8,738 | 10,322 |
| 62 | Fann Residence | 96.4 | 5 | 7,124 | 10,145 | 14,460 |
| 63 | Universite, Ecoles | 123.6 | | 0 | 0 | 0 |
| 63 b | Cent. Hospit. Univ. Fann | 26.0 | | 0 | 0 | 0 |
| 64 | Cimetiere Soumbedioune | 19.2 | | 0 | 0 | 0 |
| 65 | SICAP Fann Hock | 30.0 | 4 | 8,549 | 9,859 | 11,730 |
| 66 | Gueule Tapee | 38.0 | 4 | 12,768 | 15,162 | 18,582 |
| 67 | Medina | 160.8 | 3 | 53,639 | 63,930 | 78,631 |
| 68 | H.L.M. Centenaire | 30.8 | 4 | 8,901 | 10,195 | 12,043 |
| 69 | Gendarmerie Colobane | 16.0 | | 0 | 0 | 0 |
| 70 | Colobane | 33.2 | 4 | 9,192 | 10,752 | 12,981 |
| 71 | Marche Colobane | 1.4 | | 0 | 0 | 0 |
| 71 b | Gare Routiere Colobane | 1.2 | | 0 | 0 | 0 |
| 72 | Equip. Admin. Triangle Sud | 26.8 | | 0 | 0 | 0 |
| 73 | Equipements (stade) | 6.8 | | 0 | 0 | 0 |
| 74 | Ex Camp Lat Dior | 12.0 | | 0 | 0 | 0 |
| 76 | Reubeuss | 21.2 | 3 | 7,089 | 8,439 | 10,367 |
| 77 | Equipements (gare routiere) | 11.2 | | 0 | 0 | 0 |
| 78 | Camp Abdou Diasse | 6.0 | | 0 | 0 | |
| | sub-total | 1850.0 | | 370,831 | 432,918 | 521,611 |
| 153 | Zone Franche Industrie | 60.4 | | 0 | 0 | 0 |
| 79 | Port Autonome de Dakar | 414.0 | | 0 | 0 | 0 |
| 80 | Zone Industrielle | 450.0 | | 0 | 0 | 0 |
| 81 | Hann Village | 16.0 | 1 | 8,939 | 9,797 | 11,024 |
| 92 | Castors Municipaux Cite | 13.6 | 4 | 4,012 | 4,751 | 5,807 |
| 93 | Hann Pecheurs | 46.0 | 1 | 22,969 | 25,975 | 30,268 |
| 115 | Equipements (abattoirs) | 10.8 | | 0 | 0 | 0 |
| 115 b | Manche Poisson | 2.0 | | 0 | 0 | 0 |
| 116 | Petite Fabrique | 0.8 | | 0 | 0 | 0 |
| 117 | Parc a Materiaux Artisans | 8.0 | | 0 | 0 | 0 |
| 118 | Usine SIPS | 4.8 | | 0 | 0 | 0 |
| 122 | Village Thiaroye/Mer | 72.8 | 1 | 21,639 | 27,657 | 36,254 |
| 123 | Cite Thiaroye | 33.2 | 5 | 7,124 | 8,087 | 9,462 |
| | sub-total | 1132.4 | | 64,683 | 76,267 | 92,815 |

# TABLE B.2.1 (2) POPULATION PROJECTION (2)

(unit : person) (2/3)

| No. | Unit Name | Area(ha) | H. Type | 1993 | 2000 | 2010 |
|---|---|---|---|---|---|---|
| 31 | Camp Militaire/Camp Penal | 90.0 | | 0 | 0 | 0 |
| 32 | Foire Internationale | 38.4 | | 0 | 0 | 0 |
| 33 | Village des Arts | 2.4 | | 0 | 0 | 0 |
| 34 | Cite BCEAO | 3.6 | 5 | 639 | 811 | 1,058 |
| 35 | Cite Foire Nord | 16.4 | 4 | 3,342 | 4,167 | 5,346 |
| 36 | Cite Adama Diop | 2.0 | 5 | 370 | 458 | 584 |
| 37 | Lotissement Djily Mbaye | 34.4 | 5 | 1,284 | 3,532 | 6,742 |
| 38 | Cite Diamalaye | 15.2 | 4 | 9,007 | 9,873 | 11,111 |
| 39 | Cimetiere | 31.6 | | 0 | 0 | 0 |
| 39 b | Cite BCEAO (cadres) | 6.4 | 5 | 239 | 657 | 1,254 |
| 40 | H.L.M. Grand Medine | 5.2 | 4 | 1,830 | 2,167 | 2,647 |
| 41 | Stade Amitie | 15.6 | | 0 | 0 | 0 |
| 42 | Grand Medine | 26.0 | 2 | 16,130 | 17,057 | 18,382 |
| 43 | H.L.M. Grand Yoff/Khar Yalla | 9.6 | 4 | 4,750 | 5,502 | 6,576 |
| 43 b | SCAT-URBAM | 186.4 | 4 | 13,882 | 38,176 | 72,882 |
| 44 | H.L.M. Patte d'Oie | 13.6 | 4 | 6,648 | 7,288 | 8,201 |
| 45 | Grand Yoff/Khar Yalla | 126.0 | 3 | 42,138 | 55,242 | 73,962 |
| 82 | Equipements (CEREEG) | 12.0 | | 0 | 0 | 0 |
| 83 | Habitat Grand Standing | 9.2 | 5 | 1,237 | 1,485 | 1,840 |
| 84 | Prison Fort B | 9.2 | | 0 | 0 | 0 |
| 85 | Parc Zoologique, ISRA | 87.2 | | 0 | 0 | 0 |
| 86 | Cite Ady Niang | 14.8 | 5 | 1,587 | 2,524 | 3,863 |
| 87 | Equip. SENELEC Ecole | 12.8 | | 0 | 0 | 0 |
| 88 | Petite Cite | 2.0 | 5 | 95 | 262 | 500 |
| 89 | SICAP 2 | 221.2 | 4 | 0 | 18,333 | 35,000 |
| 98 | Cite Builders | 24.0 | 4 | 6,936 | 7,944 | 9,384 |
| 99 | Lotis. Impots et Domaine | 18.4 | 4 | 3,461 | 4,688 | 6,440 |
| 100 | SOPRIM | 7.6 | 4 | 2,412 | 2,642 | 2,972 |
| 101 | Parcelles Assainies | 386.8 | 3 | 123,905 | 154,591 | 198,428 |
| 90 | Dalifort | 18.0 | 2 | 7,779 | 8,793 | 10,242 |
| 91 | HACIENDA | 4.0 | 5 | 567 | 684 | 852 |
| 94 | Cite Faycal | 7.2 | 5 | 404 | 659 | 1,022 |
| 94 b | TECHNOPOLE | 80.0 | | 0 | 0 | 0 |
| 95 | St. de Epuration Camberene | 19.2 | | 0 | 0 | 0 |
| 96 | Ecole d'Horticulture | 4.4 | | 0 | 0 | 0 |
| 97 | Direction Espaces Verts | 52.0 | | 0 | 0 | 0 |
| 103 | Lotissements en Cours | 10.0 | 4 | 543 | 1,493 | 2,850 |
| 104 | Lotissements en Cours | 20.8 | 4 | 1,129 | 3,105 | 5,928 |
| 104 b | CADMI | 0.0 | | 0 | 0 | 0 |
| 104 t | Marche aux Poissons | 0.0 | | 0 | 0 | 0 |
| 105 | HAMO | 8.0 | 4 | 4,521 | 5,110 | 5,952 |
| 111 | Pikine Regulier | 328.8 | 3 | 85,300 | 107,988 | 140,398 |
| 112 | Cite Lobatt Fall | 4.0 | 4 | 757 | 1,032 | 1,424 |
| 113 | Gare Routiere | 1.3 | | 0 | 0 | 0 |
| 114 | Cite ICOTAF | 0.2 | 5 | 49 | 55 | 64 |
| 119 | Guinaw Rail | 110.8 | 2 | 47,887 | 54,128 | 63,045 |
| 120 | Equip. SOTRAC, OPCE, SO | 17.6 | | 0 | 0 | 0 |
| 128 | Pikine Irregulire, Thiaroye | 294.4 | 2 | 98,708 | 118,433 | 146,611 |
| | sub-total | 2408.7 | | 487,536 | 638,879 | 845,560 |
| 9 | Cite ASECNA | 6.0 | 4 | 1,509 | 1,839 | 2,310 |
| 10 | Cite Assemblee | 15.6 | 4 | 3,922 | 4,780 | 6,006 |
| 11 | Cite ASECNA (habitat eco.) | 7.6 | 4 | 1,911 | 2,329 | 2,926 |
| 12 | Equipements | 2.8 | | 0 | 0 | 0 |
| 13 | Equipements (elavage) | 6.0 | | 0 | 0 | 0 |
| 14 | Cite ASECNA (cadres) | 8.0 | 5 | 869 | 1,200 | 1,672 |
| 15 | Terrain de Sports | 25.2 | | 0 | 0 | 0 |
| 16 | Zone mil. Camp ARCHIN | 48.0 | | 0 | 0 | 0 |
| 17 | Village de Ouakam | 75.2 | 1 | 22,223 | 28,214 | 36,773 |
| 18 | Base Aerienne Terme Sud | 58.4 | | 0 | 0 | 0 |
| 19 | Cite des Douanes | 50.0 | 4 | 8,805 | 11,088 | 14,350 |
| 20 | Quartir Touba Ouakam | 42.0 | 2 | 10,674 | 12,816 | 15,876 |
| 21 | Ter. Mil. Ecole Gendarmerie | 108.0 | | 0 | 0 | 0 |
| 22 | Equipements | 0.8 | | 0 | 0 | 0 |
| 23 | Cite Africa | 14.4 | 5 | 1,528 | 2,061 | 2,822 |
| | sub-total | 468.0 | | 51,441 | 64,327 | 82,735 |

# TABLE B.2.1 (3) POPULATION PROJECTION (3)

(unit : person) (3/3)

| No. | Unit Name | Area(ha) | H. Type | 1993 | 2000 | 2010 |
|---|---|---|---|---|---|---|
| 106 | Equipement Militaire | 3.2 | | 0 | 0 | 0 |
| 107 | Lotissement Golf Nord | 6.0 | 5 | 418 | 772 | 1,278 |
| 108 | Terrain de Golf | 25.2 | | 0 | 0 | 0 |
| 108 b | Cite Golf Sud | 36.0 | 3 | 12,525 | 14,157 | 16,488 |
| 109 | Cite Adama Diop HAMO | 16.0 | 4 | 4,581 | 5,179 | 6,032 |
| 109 b | H.L.M. Guediawaye | 22.0 | 4 | 9,416 | 10,648 | 12,408 |
| 110 | Niayes | 880.8 | | 0 | 0 | 0 |
| 112 b | Cite SOTIBA | 10.0 | 4 | 2,917 | 3,297 | 3,840 |
| 129 | Pikine Guediawaye | 515.2 | 3 | 131,572 | 167,980 | 219,990 |
| 130 | Cite HAMO | 4.4 | 4 | 1,760 | 1,990 | 2,319 |
| 130 b | Cite Adama Diop/Barry | 3.6 | 4 | 1,440 | 1,628 | 1,897 |
| 131 | Golf Guediawaye | 24.8 | 3 | 4,558 | 5,592 | 7,068 |
| 132 | Lotissement | 10.4 | 4 | 705 | 1,939 | 3,702 |
| 133 | Lotissement en Cours | 7.2 | 4 | 488 | 1,343 | 2,563 |
| 134 | Lotissment | 11.6 | 4 | 787 | 2,163 | 4,130 |
| | sub-total | 1576.4 | | 171,167 | 216,688 | 281,715 |
| 121 | Camp Militaire Faidherbe | 81.6 | | 0 | 0 | 0 |
| 121 b | Redevelopment of 121, 81.6 ha | 0.0 | | 0 | 0 | 0 |
| 124 | Cite Tivaoune | 23.3 | 2 | 10,070 | 11,383 | 13,258 |
| 125 | Diaksao 1 | 38.0 | 2 | 16,423 | 18,564 | 21,622 |
| 126 | Diaksao 2 | 60.0 | 2 | 25,931 | 29,311 | 34,140 |
| 127 | Lotissement Rochette | 12.0 | 3 | 1,031 | 1,659 | 2,556 |
| 135 | Centre Transmission As | 34.0 | | 0 | 0 | 0 |
| 136 | Centre Transmission Ar | 104.0 | | 0 | 0 | 0 |
| 137 | Village de Malika | 70.0 | 1 | 18,160 | 22,990 | 29,890 |
| 138 | Extension Village de Malika | 35.6 | 1 | 9,810 | 11,092 | 12,923 |
| 139 | Centre Emetteur SONATEL | 60.8 | | 0 | 0 | 0 |
| 140 | Village de Keur Massar | 30.0 | 1 | 2,891 | 5,221 | 8,550 |
| 141 | Village Keur Abdou | 14.0 | 1 | 2,630 | 3,190 | 3,990 |
| 142 | Centre Evangelique | 4.0 | | 0 | 0 | 0 |
| 142 b | Parcelles Assainies de Malika | 418.0 | 4 | 0 | 68,100 | 130,000 |
| 143 | Village de Yeumbeul | 518.8 | 1 | 82,736 | 132,195 | 202,851 |
| 144 | Village de Boune | 16.4 | 1 | 3,081 | 3,737 | 4,674 |
| 145 | SICAP Mbao | 30.0 | 4 | 2,843 | 5,193 | 8,550 |
| 146 | Foirail | 4.0 | | 0 | 0 | 0 |
| 147 | Fass Mbao | 34.8 | 3 | 4,368 | 6,653 | 9,918 |
| 148 | Diamaguene. | 135.2 | 2 | 42,266 | 50,693 | 62,733 |
| 149 | Cite SABE | 2.0 | 5 | 443 | 518 | 626 |
| 150 | LGI (Gendarmerie) | 52.2 | | 0 | 0 | 0 |
| 151 | Centre Institut Pasteur | 40.0 | | 0 | 0 | 0 |
| 152 | Cite Gueye | 3.6 | 4 | 789 | 909 | 1,080 |
| 154 | Village Mbao Goundao | 12.8 | 1 | 2,821 | 3,188 | 3,712 |
| 155 | Village Grand Mbao | 20.8 | 1 | 6,322 | 7,376 | 8,882 |
| 156 | Centre National d'Aviculture | 22.0 | | 0 | 0 | 0 |
| 157 | Village de Kamb Goundao | 20.8 | 1 | 3,907 | 4,739 | 5,928 |
| 158 | Foret Classee de Mbao | 0.0 | | 0 | 0 | 0 |
| | sub-total | 1898.7 | | 236,522 | 386,711 | 565,883 |
| 1 | Equip. Tourist. Almadies | 30.1 | | 0 | 0 | 0 |
| 2 | OCI | 40.8 | | 0 | 0 | 0 |
| 3 | Remembrement Almadies | 100.0 | 5 | 5,757 | 11,457 | 19,600 |
| 4 | Village de Ngor | 22.0 | 1 | 7,400 | 8,801 | 10,802 |
| 5 | Zone Touristique Ngor | 39.6 | | 0 | 0 | 0 |
| 6 | Habitat Grand Standing Ngor | 5.2 | 5 | 313 | 588 | 980 |
| 7 | Ranrhar | 66.0 | 5 | 7,807 | 9,919 | 12,936 |
| 7 b | Village de Yoff | 125.2 | 1 | 36,015 | 46,457 | 61,375 |
| 8 | Aeroport | 1174.8 | | 0 | 0 | 0 |
| 102 | Village de Camberene | 64.4 | 1 | 23,607 | 27,729 | 33,617 |
| | sub-total | 1668.1 | | 80,899 | 104,951 | 139,310 |
| 159 | Zone Speciale de Mbao Gare | 647.0 | 4 | 0 | 137,600 | 262,602 |
| | Grand Total | 12051.7 | | 1,517,400 | 2,138,323 | 2,908,871 |

Source : Strategy Plan modified bythe Study Team

## TABLE B.2.2 PER-CAPITA WATER CONSUMPTION RATES

Without connection to sewerage system (unit: lpcd)

| Season | Type 1 | Type 2 | Type 3 | Type 4 | Type 5 | Type 6 |
|---|---|---|---|---|---|---|
| rainy | 29 | 29 | 43 | 85 | 127 | 127 |
| dry | 19 | 18 | 35 | 61 | 99 | 96 |
| ratio | 1.53 | 1.61 | 1.23 | 1.39 | 1.28 | 1.32 |

With connection to sewerage system (unit: lpcd)

| Season | Type 1 | Type 2 | Type 3 | Type 4 | Type 5 | Type 6 |
|---|---|---|---|---|---|---|
| rainy | 38 | 39 | 54 | 86 | 133 | 156 |
| dry | 25 | 26 | 41 | 62 | 104 | 118 |
| ratio | 1.52 | 1.50 | 1.32 | 1.39 | 1.28 | 1.32 |

Source : Strategy Plan

## TABLE B.2.3 PER-CAPITA WATER CONSUMPTION RATES FOR SEWERAGE PLANNING

(unit: lpcd)

| Type 1 | Type 2 | Type 3 | Type 4 | Type 5 | Type 6 |
|---|---|---|---|---|---|
| 80 | 100 | 150 | 200 | 250 | 400 |

Source : Strategy Plan

## TABLE B.2.4 RESULTS OF QUESTIONNAIRE SURVEY (INDUSTRIAL WATER CONSUMPTION)

| Name of factory | Main Products | Total lot area of establishment ( sq. m ) | Water Consumption | | Unit Water consumption per area (cu.m/day. lot area ha) |
|---|---|---|---|---|---|
| | | | (cu.m /mon.) | (cu.m /day) | |
| SENEPESCA S.A | Fish Canning | 4000 | 1300 | 43 | 108.0 |
| S.N.C.D.S. | Fish Canning | 23750 | 15000 | 500 | 211.0 |
| AFRICA AZOTE | Fish Canning | 5500 | 1500 | 50 | 91.0 |
| NESTLE SENEGAL | Condensed Milk | 75000 | 43800 | 1460 | 195.0 |
| SOBOA | Beer | 28000 | 10800 | 360 | 129.0 |
| SENEGAL PROTEINES | Processed Food | 3608 | 560 | 19 | 52.0 |
| ABATTOIRS DE DAKAR ( SERAS ) | Meat | 143000 | 5500 | 183 | 13.0 |
| SOFRAVIN | Beverage | 6000 | 850 | 28 | 47.0 |
| ETS SAID NOUJAIM FRERES | Candy | 3500 | 5000 | 167 | 476.0 |
| BLANCHISSERIE DU CYGNE | Textile | 6400 | 2000 | 67 | 104.0 |
| SOTIBA | Textile | 94400 | 31200 | 1040 | 110.0 |
| LA ROCHETTE DAKAR | Corrugated paper | 15000 | 600 | 20 | 13.0 |
| PARKE DAVIS AFRIQUE OUEST | Chemical | 16000 | 150 | 5 | 3.0 |
| I.C.S. | Fertilizer | 275500 | 12300 | 410 | 15.0 |
| Q - FONDS | Enamel | 8880 | 350 | 12 | 13.0 |
| Average | | 708538 | 130910 | 4364 | 62.0 |

## TABLE B.2.5 (1) WASTEWATER FLOW (PRODUCTION) (1)

(unit : m3/day) (1/5)

| No. | Unit Name | PCWC (lpcd) | | | Domestic WW Prod. | | | Industrial WW Prod. | | | Total Wastewater Flow (m3/d) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 |
| 75 | Plateau | 314 | 349 | 400 | 17,057 | 27,914 | 46,656 | 0 | 0 | 0 | 17,057 | 27,914 | 46,656 |
| 75 b | Hopitaux (PP et Dantec) | 150 | 170 | 200 | 645 | 731 | 860 | 0 | 0 | 0 | 645 | 731 | 860 |
| | sub-total | 302 | 340 | 393 | 17,702 | 28,645 | 47,516 | 0 | 0 | 0 | 17,702 | 28,645 | 47,516 |
| 46 | Equipements (CTO-CAEDA) | 150 | 170 | 200 | 75 | 85 | 100 | 0 | 0 | 0 | 75 | 85 | 100 |
| 46 b | Zone de Captage | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 47 | Gendarmerie Front de Terre | 150 | 170 | 200 | 30 | 34 | 40 | 0 | 0 | 0 | 30 | 34 | 40 |
| 48 | Cite Front de Terre Milli. | 199 | 220 | 250 | 244 | 348 | 522 | 0 | 0 | 0 | 244 | 348 | 522 |
| 49 | Equipements Sportifs | 150 | 170 | 200 | 4 | 4 | 5 | 0 | 0 | 0 | 4 | 4 | 5 |
| 50 | SODIDA & Zone Artisanale | 150 | 170 | 200 | 450 | 510 | 600 | 0 | 0 | 0 | 450 | 510 | 600 |
| 50 b | Zone Industrielle | 150 | 170 | 200 | 203 | 230 | 270 | 0 | 0 | 0 | 203 | 230 | 270 |
| 52 | SICAP | 148 | 169 | 200 | 18,631 | 24,367 | 34,064 | 0 | 0 | 0 | 18,631 | 24,367 | 34,064 |
| 24 | Cite SOTRAC-Mermoz | 236 | 242 | 250 | 340 | 439 | 588 | 0 | 0 | 0 | 340 | 439 | 588 |
| 25 | Fenetre Mermoz | 236 | 242 | 250 | 495 | 663 | 915 | 0 | 0 | 0 | 495 | 663 | 915 |
| 26 | Services Tech. SOTRAC | 150 | 170 | 200 | 71 | 80 | 94 | 0 | 0 | 0 | 71 | 80 | 94 |
| 27 | Equipements Scolaires | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | Mermoz-Fann | 236 | 242 | 250 | 750 | 973 | 1,305 | 0 | 0 | 0 | 750 | 973 | 1,305 |
| 29 | Terrain Militaire | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | Zone Equipements | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 51 | H.L.M. Nimzatt | 172 | 184 | 200 | 6,429 | 7,540 | 9,223 | 0 | 0 | 0 | 6,429 | 7,540 | 9,223 |
| 51 b | Cite Douanes | 172 | 184 | 200 | 438 | 631 | 938 | 0 | 0 | 0 | 438 | 631 | 938 |
| 52 b | Grand Dakar | 63 | 99 | 150 | 1,609 | 3,002 | 5,575 | 0 | 0 | 0 | 1,609 | 3,002 | 5,575 |
| 52 t | Grand Dakar Usine | 63 | 99 | 150 | 847 | 1,580 | 2,934 | 0 | 0 | 0 | 847 | 1,580 | 2,934 |
| 53 | Zone Equip. Cerf Volant | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 53 b | Ouagou Niaye | 100 | 141 | 200 | 615 | 1,023 | 1,768 | 0 | 0 | 0 | 615 | 1,023 | 1,768 |
| 53 t | BOPP | 100 | 141 | 200 | 393 | 635 | 1,064 | 0 | 0 | 0 | 393 | 635 | 1,064 |
| 54 | H.L.M. Fass Ancien | 157 | 175 | 200 | 237 | 289 | 372 | 0 | 0 | 0 | 237 | 289 | 372 |
| 55 | Fass | 100 | 121 | 150 | 463 | 614 | 856 | 0 | 0 | 0 | 463 | 614 | 856 |
| 55 b | Zone A et B | 157 | 175 | 200 | 869 | 1,133 | 1,564 | 0 | 0 | 0 | 869 | 1,133 | 1,564 |
| 56 | H.L.M. Fass Paillotes | 157 | 175 | 200 | 330 | 431 | 594 | 0 | 0 | 0 | 330 | 431 | 594 |
| 57 | Fass Delorme | 100 | 141 | 200 | 1,006 | 1,624 | 2,721 | 0 | 0 | 0 | 1,006 | 1,624 | 2,721 |
| 58 | Marche de Fass | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 59 | Point E | 159 | 196 | 250 | 1,478 | 2,298 | 3,800 | 0 | 0 | 0 | 1,478 | 2,298 | 3,800 |
| 59 b | Lycee | 150 | 170 | 200 | 15 | 17 | 20 | 0 | 0 | 0 | 15 | 17 | 20 |
| 60 | Ecole de Police | 150 | 170 | 200 | 80 | 90 | 106 | 0 | 0 | 0 | 80 | 90 | 106 |
| 61 | SICAP Mermoz | 148 | 169 | 200 | 1,129 | 1,477 | 2,064 | 0 | 0 | 0 | 1,129 | 1,477 | 2,064 |
| 62 | Fann Residence | 159 | 196 | 250 | 1,133 | 1,988 | 3,615 | 0 | 0 | 0 | 1,133 | 1,988 | 3,615 |
| 63 | Universite, Ecoles | 150 | 170 | 200 | 1,500 | 1,700 | 2,000 | 0 | 0 | 0 | 1,500 | 1,700 | 2,000 |
| 63 b | Cent. Hospit. Univ. Fann | 150 | 170 | 200 | 1,260 | 1,428 | 1,680 | 0 | 0 | 0 | 1,260 | 1,428 | 1,680 |
| 64 | Cimetiere Soumbedioune | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 65 | SICAP Fann Hock | 157 | 175 | 200 | 1,342 | 1,725 | 2,346 | 0 | 0 | 0 | 1,342 | 1,725 | 2,346 |

## TABLE B.2.5 (2) WASTEWATER FLOW (PRODUCTION) (2)

(unit : m3/day) (2/5)

| No. | Unit Name | PCWC (lpcd) | | | Domestic WW Prod. | | | Industrial WW Prod. | | | Total Wastewater Flow (m3/d) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 |
| 66 | Gueule Tapee | 100 | 141 | 200 | 1,277 | 2,138 | 3,716 | 0 | 0 | 0 | 1,277 | 2,138 | 3,716 |
| 67 | Medina | 100 | 121 | 150 | 5,364 | 7,736 | 11,795 | 0 | 0 | 0 | 5,364 | 7,736 | 11,795 |
| 68 | H.L.M. Centenaire | 157 | 175 | 200 | 1,397 | 1,784 | 2,409 | 0 | 0 | 0 | 1,397 | 1,784 | 2,409 |
| 69 | Gendarmerie Colobane | 150 | 170 | 200 | 135 | 153 | 180 | 0 | 0 | 0 | 135 | 153 | 180 |
| 70 | Colobane | 100 | 141 | 200 | 919 | 1,516 | 2,596 | 0 | 0 | 0 | 919 | 1,516 | 2,596 |
| 71 | Marche Colobane | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 71 b | Gare Routiere Colobane | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | Equip. Admin. Triangle Sud | 150 | 170 | 200 | 15 | 17 | 20 | 0 | 0 | 0 | 15 | 17 | 20 |
| 73 | Equipements (stade) | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 74 | Ex Camp Lat Dior | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 76 | Reubeuss | 128 | 137 | 150 | 907 | 1,156 | 1,555 | 0 | 0 | 0 | 907 | 1,156 | 1,555 |
| 77 | Equipements (gare routiere) | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 78 | Camp Abdou Diasse | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | sub-total | 132 | 156 | 190 | 52,480 | 71,458 | 104,014 | 0 | 0 | 0 | 52,480 | 71,458 | 104,014 |
| 153 | Zone Franche Industrie | | | | 0 | 0 | 0 | 2,174 | 2,174 | 2,174 | 2,174 | 2,174 | 2,174 |
| 79 | Port Autonome de Dakar | 150 | 170 | 200 | 3,060 | 3,468 | 4,080 | 1,188 | 3,312 | 6,372 | 4,248 | 6,780 | 10,452 |
| 80 | Zone Industrielle | 150 | 170 | 200 | 825 | 935 | 1,100 | 7,488 | 11,124 | 16,200 | 8,313 | 12,059 | 17,300 |
| 81 | Hann Village | 72 | 75 | 80 | 644 | 735 | 882 | | | | 644 | 735 | 882 |
| 92 | Castors Municipaux Cite | 151 | 171 | 200 | 606 | 812 | 1,161 | 0 | 0 | 0 | 606 | 812 | 1,161 |
| 93 | Hann Pecheurs | 75 | 77 | 80 | 1,723 | 2,000 | 2,421 | 0 | 0 | 0 | 1,723 | 2,000 | 2,421 |
| 115 | Equipements (abattoirs) | 150 | 170 | 200 | 15 | 17 | 20 | 180 | 180 | 180 | 195 | 197 | 200 |
| 115 b | Manche Poisson | 150 | 170 | 200 | 15 | 17 | 20 | 180 | 180 | 180 | 195 | 197 | 200 |
| 116 | Petite Fabrique | | | | 0 | 0 | 0 | 29 | 29 | 29 | 29 | 29 | 29 |
| 117 | Parc a Materiaux Artisans | | | | 0 | 0 | 0 | 288 | 288 | 288 | 288 | 288 | 288 |
| 118 | Usine SIPS | | | | 0 | 0 | 0 | 173 | 173 | 173 | 173 | 173 | 173 |
| 122 | Village Thiaroye/Mer | 65 | 71 | 80 | 1,407 | 1,964 | 2,900 | 0 | 0 | 0 | 1,407 | 1,964 | 2,900 |
| 123 | Cite Thiaroye | 241 | 245 | 250 | 1,717 | 1,981 | 2,366 | 0 | 0 | 0 | 1,717 | 1,981 | 2,366 |
| | sub-total | 110 | 117 | 126 | 10,012 | 11,929 | 14,950 | 11,700 | 17,460 | 25,596 | 21,712 | 29,389 | 40,546 |
| 31 | Camp Militaire/Camp Penal | 150 | 170 | 200 | 150 | 170 | 200 | 0 | 0 | 0 | 150 | 170 | 200 |
| 32 | Foire Internationale | 150 | 170 | 200 | 4 | 4 | 5 | 0 | 0 | 0 | 4 | 4 | 5 |
| 33 | Village des Arts | 150 | 170 | 200 | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 2 |
| 34 | Cite BCEAO | 145 | 188 | 250 | 93 | 152 | 265 | 0 | 0 | 0 | 93 | 152 | 265 |
| 35 | Cite Foire Nord | 91 | 136 | 200 | 304 | 567 | 1,069 | 0 | 0 | 0 | 304 | 567 | 1,069 |
| 36 | Cite Adama Diop | 199 | 220 | 250 | 74 | 101 | 146 | 0 | 0 | 0 | 74 | 101 | 146 |
| 37 | Lotissement Djily Mbaye | 199 | 220 | 250 | 256 | 777 | 1,686 | 0 | 0 | 0 | 256 | 777 | 1,686 |
| 38 | Cite Diamalaye | 91 | 136 | 200 | 820 | 1,343 | 2,222 | 0 | 0 | 0 | 820 | 1,343 | 2,222 |
| 39 | Cimetiere | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 39 b | Cite BCEAO (cadres) | 145 | 188 | 250 | 35 | 124 | 314 | 0 | 0 | 0 | 35 | 124 | 314 |
| 40 | H.L.M. Grand Medine | 91 | 136 | 200 | 167 | 295 | 529 | 0 | 0 | 0 | 167 | 295 | 529 |
| 41 | Stade Amitie | 150 | 170 | 200 | 4 | 4 | 5 | 0 | 0 | 0 | 4 | 4 | 5 |

## TABLE B.2.5 (3) WASTEWATER FLOW (PRODUCTION) (3)

(unit : m3/day) (3/5)

| No. | Unit Name | PCWC (lpcd) | | | Domestic WW Prod. | | | Industrial WW Prod. | | | Total Wastewater Flow (m3/d) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 |
| 42 | Grand Medine | 39 | 64 | 100 | 629 | 1,092 | 1,838 | 0 | 0 | 0 | 629 | 1,092 | 1,838 |
| 43 | H.L.M. Grand Yoff/Khar Yalla | 125 | 156 | 200 | 594 | 858 | 1,315 | 0 | 0 | 0 | 594 | 858 | 1,315 |
| 43 b | SCAT-URBAM | 125 | 156 | 200 | 1,735 | 5,955 | 14,576 | 0 | 0 | 0 | 1,735 | 5,955 | 14,576 |
| 44 | H.L.M. Patte d'Oie | 125 | 156 | 200 | 831 | 1,137 | 1,640 | 0 | 0 | 0 | 831 | 1,137 | 1,640 |
| 45 | Grand Yoff/Khar Yalla | 79 | 108 | 150 | 3,329 | 5,966 | 11,094 | 0 | 0 | 0 | 3,329 | 5,966 | 11,094 |
| 82 | Equipements (CEREEG) | 150 | 170 | 200 | 15 | 17 | 20 | 0 | 0 | 0 | 15 | 17 | 20 |
| 83 | Habitat Grand Standing | 275 | 275 | 275 | 340 | 408 | 506 | 0 | 0 | 0 | 340 | 408 | 506 |
| 84 | Prison Fort B | 150 | 170 | 200 | 30 | 34 | 40 | 0 | 0 | 0 | 30 | 34 | 40 |
| 85 | Parc Zoologique, ISRA | 150 | 170 | 200 | 150 | 170 | 200 | 0 | 0 | 0 | 150 | 170 | 200 |
| 86 | Cite Ady Niang | 199 | 220 | 250 | 316 | 555 | 966 | 0 | 0 | 0 | 316 | 555 | 966 |
| 87 | Eouip. SENELEC Ecole | 150 | 170 | 200 | 38 | 43 | 50 | 0 | 0 | 0 | 38 | 43 | 50 |
| 88 | Petite Cite | 199 | 220 | 250 | 19 | 58 | 125 | 0 | 0 | 0 | 19 | 58 | 125 |
| 89 | SICAP 2 | 125 | 156 | 200 | 0 | 2,860 | 7,000 | 0 | 0 | 0 | 0 | 2,860 | 7,000 |
| 98 | Cite Builders | 91 | 136 | 200 | 631 | 1,080 | 1,877 | 0 | 0 | 0 | 631 | 1,080 | 1,877 |
| 99 | Lotis. Impots et Domaine | 91 | 136 | 200 | 315 | 638 | 1,288 | 0 | 0 | 0 | 315 | 638 | 1,288 |
| 100 | SOPRIM | 91 | 136 | 200 | 219 | 359 | 594 | 0 | 0 | 0 | 219 | 359 | 594 |
| 101 | Parcelles Assainies | 58 | 96 | 150 | 7,186 | 14,841 | 29,764 | 0 | 0 | 0 | 7,186 | 14,841 | 29,764 |
| 90 | Dalifort | 65 | 79 | 100 | 506 | 695 | 1,024 | 0 | 0 | 0 | 506 | 695 | 1,024 |
| 91 | HACIENDA | 241 | 245 | 250 | 137 | 168 | 213 | 0 | 0 | 0 | 137 | 168 | 213 |
| 94 | Cite Faycal | 145 | 188 | 250 | 59 | 124 | 256 | 0 | 0 | 0 | 59 | 124 | 256 |
| 94 b | TECHNOPOLE | 100 | 100 | 100 | 0 | 700 | 1,225 | 0 | 570 | 1,410 | 0 | 1,270 | 2,635 |
| 95 | St. de Epuration Camberene | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 96 | Ecole d'Horticulture | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 97 | Direction Espaces Verts | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 103 | Lotissements en Cours | 125 | 156 | 200 | 68 | 233 | 570 | 0 | 0 | 0 | 68 | 233 | 570 |
| 104 | Lotissements en Cours | 125 | 156 | 200 | 141 | 484 | 1,186 | 0 | 0 | 0 | 141 | 484 | 1,186 |
| 104 b | CADMI | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 104 t | Marche aux Poissons | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 105 | HAMO | 92 | 136 | 200 | 416 | 695 | 1,190 | 0 | 0 | 0 | 416 | 695 | 1,190 |
| 111 | Pikine Regulier | 96 | 118 | 150 | 8,189 | 12,743 | 21,060 | 0 | 0 | 0 | 8,189 | 12,743 | 21,060 |
| 112 | Cite Lobatt Fall | 151 | 171 | 200 | 114 | 176 | 285 | 0 | 0 | 0 | 114 | 176 | 285 |
| 113 | Gare Routiere | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 114 | Cite ICOTAF | 241 | 245 | 250 | 12 | 13 | 16 | 580 | 580 | 580 | 592 | 593 | 596 |
| 119 | Guinaw Rail | 98 | 99 | 100 | 4,693 | 5,359 | 6,305 | 0 | 0 | 0 | 4,693 | 5,359 | 6,305 |
| 120 | Equip. SOTRAC, OPCE, SO | | | | 0 | 0 | 0 | 634 | 634 | 634 | 634 | 634 | 634 |
| 128 | Pikine Irregulire, Thiaroye | 65 | 79 | 100 | 6,416 | 9,356 | 14,661 | 0 | 0 | 0 | 6,416 | 9,356 | 14,661 |
| | sub-total | 78 | 108 | 148 | 39,037 | 70,356 | 127,327 | 1,214 | 1,784 | 2,624 | 40,251 | 72,140 | 129,951 |

## TABLE B.2.5 (4) WASTEWATER FLOW (PRODUCTION) (4)

(unit : m3/day) (4/5)

| No. | Unit Name | PCWC (lpcd) | | | Domestic WW Prod. | | | Industrial WW Prod. | | | Total Wastewater Flow (m3/d) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 |
| 9 | Cite ASECNA | 125 | 156 | 200 | 189 | 287 | 462 | 0 | 0 | 0 | 189 | 287 | 462 |
| 10 | Cite Assemblee | 125 | 156 | 200 | 490 | 746 | 1,201 | 0 | 0 | 0 | 490 | 746 | 1,201 |
| 11 | Cite ASECNA (habitat eco.) | 125 | 156 | 200 | 239 | 363 | 585 | 0 | 0 | 0 | 239 | 363 | 585 |
| 12 | Equipements | 150 | 170 | 200 | 4 | 4 | 5 | 0 | 0 | 0 | 4 | 4 | 5 |
| 13 | Equipements (elavage) | 150 | 170 | 200 | 4 | 4 | 5 | 0 | 0 | 0 | 4 | 4 | 5 |
| 14 | Cite ASECNA (cadres) | 199 | 220 | 250 | 173 | 264 | 418 | 0 | 0 | 0 | 173 | 264 | 418 |
| 15 | Terrain de Sports | 150 | 170 | 200 | 8 | 9 | 10 | 0 | 0 | 0 | 8 | 9 | 10 |
| 16 | Zone mil. Camp ARCHIN | 150 | 170 | 200 | 30 | 34 | 40 | 0 | 0 | 0 | 30 | 34 | 40 |
| 17 | Village de Ouakam | 54 | 65 | 80 | 1,200 | 1,834 | 2,942 | 0 | 0 | 0 | 1,200 | 1,834 | 2,942 |
| 18 | Base Aerienne Terme Sud | 150 | 170 | 200 | 15 | 17 | 20 | 0 | 0 | 0 | 15 | 17 | 20 |
| 19 | Cite des Douanes | 125 | 156 | 200 | 1,101 | 1,730 | 2,870 | 0 | 0 | 0 | 1,101 | 1,730 | 2,870 |
| 20 | Quartir Touba Ouakam | 54 | 73 | 100 | 576 | 936 | 1,588 | 0 | 0 | 0 | 576 | 936 | 1,588 |
| 21 | Ter. Mil. Ecole Gendarmerie | 150 | 170 | 200 | 150 | 170 | 200 | 0 | 0 | 0 | 150 | 170 | 200 |
| 22 | Equipements | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | Cite Africa | 244 | 246 | 250 | 373 | 507 | 706 | 0 | 0 | 0 | 373 | 507 | 706 |
| | sub-total | 86 | 105 | 131 | 4,552 | 6,905 | 11,052 | 0 | 0 | 0 | 4,552 | 6,905 | 11,052 |
| 106 | Equipement Militaire | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 107 | Lotissement Golf Nord | 198 | 219 | 250 | 83 | 169 | 320 | 0 | 0 | 0 | 83 | 169 | 320 |
| 108 | Terrain de Golf | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 108 b | Cite Golf Sud | 79 | 108 | 150 | 989 | 1,529 | 2,473 | 0 | 0 | 0 | 989 | 1,529 | 2,473 |
| 109 | Cite Adama Diop HAMO | 124 | 155 | 200 | 568 | 803 | 1,206 | 0 | 0 | 0 | 568 | 803 | 1,206 |
| 109 b | H.L.M. Guediawaye | 126 | 156 | 200 | 1,186 | 1,661 | 2,482 | 0 | 0 | 0 | 1,186 | 1,661 | 2,482 |
| 110 | Niayes | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 112 b | Cite SOTIBA | 151 | 171 | 200 | 440 | 564 | 768 | 0 | 0 | 0 | 440 | 564 | 768 |
| 129 | Pikine Guediawaye | 79 | 108 | 150 | 10,394 | 18,142 | 32,999 | 0 | 0 | 0 | 10,394 | 18,142 | 32,999 |
| 130 | Cite HAMO | 124 | 155 | 200 | 218 | 308 | 464 | 0 | 0 | 0 | 218 | 308 | 464 |
| 130 b | Cite Adama Diop/Barry | 124 | 155 | 200 | 179 | 252 | 379 | 0 | 0 | 0 | 179 | 252 | 379 |
| 131 | Golf Guediawaye | 79 | 108 | 150 | 360 | 604 | 1,060 | 0 | 0 | 0 | 360 | 604 | 1,060 |
| 132 | Lotissement | 124 | 155 | 200 | 87 | 301 | 740 | 0 | 0 | 0 | 87 | 301 | 740 |
| 133 | Lotissement en Cours | 124 | 155 | 200 | 61 | 208 | 513 | 0 | 0 | 0 | 61 | 208 | 513 |
| 134 | Lotissment | 124 | 155 | 200 | 98 | 335 | 826 | 0 | 0 | 0 | 98 | 335 | 826 |
| | sub-total | 86 | 115 | 157 | 14,663 | 24,876 | 44,230 | 0 | 0 | 0 | 14,663 | 24,876 | 44,230 |
| 121 | Camp Militaire Faidherbe | 150 | 170 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 121 b | Redevelopment of 121, 81.6 ha | 150 | 170 | 200 | 7,500 | 8,500 | 10,000 | 0 | 0 | 0 | 7,500 | 8,500 | 10,000 |
| 124 | Cite Tivaoune | 65 | 79 | 100 | 655 | 899 | 1,326 | 0 | 0 | 0 | 655 | 899 | 1,326 |
| 125 | Diaksao 1 | 65 | 79 | 100 | 1,067 | 1,467 | 2,162 | 0 | 0 | 0 | 1,067 | 1,467 | 2,162 |
| 126 | Diaksao 2 | 65 | 79 | 100 | 1,686 | 2,316 | 3,414 | 0 | 0 | 0 | 1,686 | 2,316 | 3,414 |
| 127 | Lotissement Rochette | 95 | 118 | 150 | 98 | 196 | 383 | 0 | 0 | 0 | 98 | 196 | 383 |
| 135 | Centre Transmission As | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 136 | Centre Transmission Ar | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 137 | Village de Malika | 65 | 71 | 80 | 1,180 | 1,632 | 2,391 | 0 | 0 | 0 | 1,180 | 1,632 | 2,391 |

# TABLE B.2.5 (5) WASTEWATER FLOW (PRODUCTION) (5)

(unit : m3/day) (5/5)

| No. | Unit Name | PCWC (lpcd) | | | Domestic WW Prod. | | | Industrial WW Prod. | | | Total Wastewater Flow (m3/d) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 |
| 138 | Extension Village de Malika | 65 | 71 | 80 | 638 | 788 | 1,034 | 0 | 0 | 0 | 638 | 788 | 1,034 |
| 139 | Centre Emetteur SONATEL | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 140 | Village de Keur Massar | 65 | 71 | 80 | 188 | 371 | 684 | 0 | 0 | 0 | 188 | 371 | 684 |
| 141 | Village Keur Abdou | 65 | 71 | 80 | 171 | 226 | 319 | 0 | 0 | 0 | 171 | 226 | 319 |
| 142 | Centre Evangelique | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 142 b | Parcelles Assainies de Malika | 124 | 155 | 200 | 0 | 10,556 | 26,000 | 0 | 0 | 0 | 0 | 10,556 | 26,000 |
| 143 | Village de Yeumbeul | 55 | 65 | 80 | 4,550 | 8,593 | 16,228 | 0 | 0 | 0 | 4,550 | 8,593 | 16,228 |
| 144 | Village de Boune | 65 | 71 | 80 | 200 | 265 | 374 | 0 | 0 | 0 | 200 | 265 | 374 |
| 145 | SICAP Mbao | 151 | 171 | 200 | 429 | 888 | 1,710 | 0 | 0 | 0 | 429 | 888 | 1,710 |
| 146 | Foirail | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 147 | Fass Mbao | 96 | 118 | 150 | 419 | 785 | 1,488 | 0 | 0 | 0 | 419 | 785 | 1,488 |
| 148 | Diamaguene. | 65 | 79 | 100 | 2,747 | 4,005 | 6,273 | 0 | 0 | 0 | 2,747 | 4,005 | 6,273 |
| 149 | Cite SABE | 241 | 245 | 250 | 107 | 127 | 157 | 0 | 0 | 0 | 107 | 127 | 157 |
| 150 | LGI (Gendarmerie) | 150 | 170 | 200 | 75 | 85 | 100 | 0 | 0 | 0 | 75 | 85 | 100 |
| 151 | Centre Institut Pasteur | 150 | 170 | 200 | 8 | 9 | 10 | 0 | 0 | 0 | 8 | 9 | 10 |
| 152 | Cite Gueye | 151 | 171 | 200 | 119 | 155 | 216 | 0 | 0 | 0 | 119 | 155 | 216 |
| 154 | Village Mbao Goundao | 65 | 71 | 80 | 183 | 226 | 297 | 0 | 0 | 0 | 183 | 226 | 297 |
| 155 | Village Grand Mbao | 65 | 71 | 80 | 411 | 524 | 711 | 0 | 0 | 0 | 411 | 524 | 711 |
| 156 | Centre National d'Aviculture | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 157 | Village de Kamb Goundao | 65 | 71 | 80 | 254 | 336 | 474 | 0 | 0 | 0 | 254 | 336 | 474 |
| 158 | Foret Classee de Mbao | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | sub-total | 79 | 98 | 123 | 22,685 | 42,949 | 75,751 | 0 | 0 | 0 | 22,685 | 42,949 | 75,751 |
| 1 | Equip. Tourist. Almadies | 150 | 170 | 200 | 450 | 510 | 600 | 0 | 0 | 0 | 450 | 510 | 600 |
| 2 | OCI | 150 | 170 | 200 | 15 | 17 | 20 | 0 | 0 | 0 | 15 | 17 | 20 |
| 3 | Remembrement Almadies | 199 | 220 | 250 | 1,146 | 2,521 | 4,900 | 0 | 0 | 0 | 1,146 | 2,521 | 4,900 |
| 4 | Village de Ngor | 54 | 65 | 80 | 400 | 572 | 864 | 0 | 0 | 0 | 400 | 572 | 864 |
| 5 | Zone Touristique Ngor | 150 | 170 | 200 | 375 | 425 | 500 | 0 | 0 | 0 | 375 | 425 | 500 |
| 6 | Habitat Grand Standing Ngor | 199 | 220 | 250 | 62 | 129 | 245 | 0 | 0 | 0 | 62 | 129 | 245 |
| 7 | Ranrhar | 199 | 220 | 250 | 1,554 | 2,182 | 3,234 | 0 | 0 | 0 | 1,554 | 2,182 | 3,234 |
| 7 b | Village de Yoff | 54 | 65 | 80 | 1,945 | 3,020 | 4,910 | 0 | 0 | 0 | 1,945 | 3,020 | 4,910 |
| 8 | Aeroport | 150 | 170 | 200 | 75 | 85 | 100 | 0 | 0 | 0 | 75 | 85 | 100 |
| 102 | Village de Camberene | 39 | 56 | 80 | 921 | 1,553 | 2,689 | 0 | 0 | 0 | 921 | 1,553 | 2,689 |
| | sub-total | 80 | 99 | 124 | 6,943 | 11,014 | 18,062 | 0 | 0 | 0 | 6,943 | 11,014 | 18,062 |
| 159 | Zone Speciale de Mbao Gare | 150 | 170 | 200 | 0 | 23,392 | 52,520 | 0 | 0 | 0 | 0 | 23,392 | 52,520 |
| | Grand Total | 102 | 129 | 163 | 168,074 | 291,524 | 495,422 | 12,914 | 19,244 | 28,220 | 180,988 | 310,768 | 523,642 |

Source : Study Team

# TABLE B.2.6 (1) POLLUTION LOAD PRODUCED (BOD) (1)

(unit :kg/day) (1/3)

| No. | Unit Name | Domes. BOD Load (kg/day) | | | Indus. BOD Load (kg/d) | | | Total BOD Producted (kg/d) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 |
| 75 | Plateau | 2,553 | 4,159 | 6,998 | 0 | 0 | 0 | 2,553 | 4,159 | 6,998 |
| 75 b | Hopitaux (PP et Dantec) | 202 | 224 | 258 | 0 | 0 | 0 | 202 | 224 | 258 |
| | sub-total | 2,755 | 4,383 | 7,256 | 0 | 0 | 0 | 2,755 | 4,383 | 7,256 |
| 46 | Equipements (CTO-CAEDA) | 24 | 26 | 30 | 0 | 0 | 0 | 24 | 26 | 30 |
| 46 b | Zone de Captage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 47 | Gendarmerie Front de Terre | 9 | 10 | 12 | 0 | 0 | 0 | 9 | 10 | 12 |
| 48 | Cite Front de Terre Milli. | 58 | 82 | 125 | 0 | 0 | 0 | 58 | 82 | 125 |
| 49 | Equipements Sportifs | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 2 |
| 50 | SODIDA & Zone Artisanale | 141 | 156 | 180 | 0 | 0 | 0 | 141 | 156 | 180 |
| 50 b | Zone Industrielle | 63 | 70 | 81 | 0 | 0 | 0 | 63 | 70 | 81 |
| 52 | SICAP | 5,917 | 7,498 | 10,219 | 0 | 0 | 0 | 5,917 | 7,498 | 10,219 |
| 24 | Cite SOTRAC-Mermoz | 68 | 94 | 141 | 0 | 0 | 0 | 68 | 94 | 141 |
| 25 | Fenetre Mermoz | 99 | 142 | 219 | 0 | 0 | 0 | 99 | 142 | 219 |
| 26 | Services Tech. SOTRAC | 22 | 24 | 28 | 0 | 0 | 0 | 22 | 24 | 28 |
| 27 | Equipements Scolaires | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | Mermoz-Fann | 149 | 209 | 313 | 0 | 0 | 0 | 149 | 209 | 313 |
| 29 | Terrain Militaire | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | Zone Equipements | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 51 | H.L.M. Nimzatt | 1,757 | 2,131 | 2,767 | 0 | 0 | 0 | 1,757 | 2,131 | 2,767 |
| 51 b | Cite Douanes | 120 | 178 | 282 | 0 | 0 | 0 | 120 | 178 | 282 |
| 52 b | Grand Dakar | 1,200 | 1,577 | 2,230 | 0 | 0 | 0 | 1,200 | 1,577 | 2,230 |
| 52 t | Grand Dakar Usine | 632 | 830 | 1,174 | 0 | 0 | 0 | 632 | 830 | 1,174 |
| 53 | Zone Equip. Cerf Volant | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 53 b | Ouagou Niaye | 289 | 377 | 530 | 0 | 0 | 0 | 289 | 377 | 530 |
| 53 t | BOPP | 185 | 234 | 319 | 0 | 0 | 0 | 185 | 234 | 319 |
| 54 | H.L.M. Fass Ancien | 71 | 86 | 112 | 0 | 0 | 0 | 71 | 86 | 112 |
| 55 | Fass | 218 | 264 | 343 | 0 | 0 | 0 | 218 | 264 | 343 |
| 55 b | Zone A et B | 260 | 337 | 469 | 0 | 0 | 0 | 260 | 337 | 469 |
| 56 | H.L.M. Fass Paillotes | 99 | 128 | 178 | 0 | 0 | 0 | 99 | 128 | 178 |
| 57 | Fass Delorme | 473 | 599 | 816 | 0 | 0 | 0 | 473 | 599 | 816 |
| 58 | Marche de Fass | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 59 | Point E | 437 | 610 | 912 | 0 | 0 | 0 | 437 | 610 | 912 |
| 59 b | Lycee | 5 | 5 | 6 | 0 | 0 | 0 | 5 | 5 | 6 |
| 60 | Ecole de Police | 25 | 28 | 32 | 0 | 0 | 0 | 25 | 28 | 32 |
| 61 | SICAP Mermoz | 359 | 454 | 619 | 0 | 0 | 0 | 359 | 454 | 619 |
| 62 | Fann Residence | 335 | 528 | 868 | 0 | 0 | 0 | 335 | 528 | 868 |
| 63 | Universite, Ecoles | 470 | 520 | 600 | 0 | 0 | 0 | 470 | 520 | 600 |
| 63 b | Cent. Hospit. Univ. Fann | 395 | 437 | 504 | 0 | 0 | 0 | 395 | 437 | 504 |
| 64 | Cimetiere Soumbedioune | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 65 | SICAP Fann Hock | 402 | 513 | 704 | 0 | 0 | 0 | 402 | 513 | 704 |
| 66 | Gueule Tapee | 600 | 788 | 1,115 | 0 | 0 | 0 | 600 | 788 | 1,115 |
| 67 | Medina | 2,521 | 3,324 | 4,718 | 0 | 0 | 0 | 2,521 | 3,324 | 4,718 |
| 68 | H.L.M. Centenaire | 418 | 530 | 723 | 0 | 0 | 0 | 418 | 530 | 723 |
| 69 | Gendarmerie Colobane | 42 | 47 | 54 | 0 | 0 | 0 | 42 | 47 | 54 |
| 70 | Colobane | 432 | 559 | 779 | 0 | 0 | 0 | 432 | 559 | 779 |
| 71 | Marche Colobane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 71 b | Gare Routiere Colobane | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | Equip. Admin. Triangle Sud | 5 | 5 | 6 | 0 | 0 | 0 | 5 | 5 | 6 |
| 73 | Equipements (stade) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 74 | Ex Camp Lat Dior | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 76 | Reubeuss | 333 | 439 | 622 | 0 | 0 | 0 | 333 | 439 | 622 |
| 77 | Equipements (gare routiere) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 78 | Camp Abdou Diasse | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | sub-total | 18,634 | 23,840 | 32,832 | 0 | 0 | 0 | 18,634 | 23,840 | 32,832 |
| 153 | Zone Franche Industrie | 0 | 0 | 0 | 1,978 | 1,978 | 1,978 | 1,978 | 1,978 | 1,978 |
| 79 | Port Autonome de Dakar | 959 | 1,061 | 1,224 | 1,081 | 3,014 | 5,799 | 2,040 | 4,075 | 7,023 |
| 80 | Zone Industrielle | 259 | 286 | 330 | 6,814 | 10,123 | 14,742 | 7,073 | 10,409 | 15,072 |
| 81 | Hann Village | 420 | 509 | 661 | 0 | 0 | 0 | 420 | 509 | 661 |
| 92 | Castors Municipaux Cite | 189 | 247 | 348 | 0 | 0 | 0 | 189 | 247 | 348 |
| 93 | Hann Pecheurs | 1,080 | 1,351 | 1,816 | 0 | 0 | 0 | 1,080 | 1,351 | 1,816 |
| 115 | Equipements (abattoirs) | 5 | 5 | 6 | 164 | 164 | 164 | 169 | 169 | 170 |
| 115 b | Manche Poisson | 5 | 5 | 6 | 164 | 164 | 164 | 169 | 169 | 170 |
| 116 | Petite Fabrique | 0 | 0 | 0 | 26 | 26 | 26 | 26 | 26 | 26 |
| 117 | Parc a Materiaux Artisans | 0 | 0 | 0 | 262 | 262 | 262 | 262 | 262 | 262 |
| 118 | Usine SIPS | 0 | 0 | 0 | 157 | 157 | 157 | 157 | 157 | 157 |
| 122 | Village Thiaroye/Mer | 1,017 | 1,438 | 2,175 | 0 | 0 | 0 | 1,017 | 1,438 | 2,175 |
| 123 | Cite Thiaroye | 335 | 421 | 568 | 0 | 0 | 0 | 335 | 421 | 568 |
| | sub-total | 4,269 | 5,323 | 7,134 | 10,646 | 15,888 | 23,292 | 14,915 | 21,211 | 30,426 |

# TABLE B.2.6 (2) POLLUTION LOAD PRODUCED (BOD) (2)

(unit :kg/day) (2/3)

| No. | Unit Name | Domes. BOD Load (kg/day) | | | Indus. BOD Load (kg/d) | | | Total BOD Producted (kg/d) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 |
| 31 | Camp Militaire/Camp Penal | 47 | 52 | 60 | 0 | 0 | 0 | 47 | 52 | 60 |
| 32 | Foire Internationale | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 2 |
| 33 | Village des Arts | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 34 | Cite BCEAO | 30 | 42 | 63 | 0 | 0 | 0 | 30 | 42 | 63 |
| 35 | Cite Foire Nord | 157 | 217 | 321 | 0 | 0 | 0 | 157 | 217 | 321 |
| 36 | Cite Adama Diop | 17 | 24 | 35 | 0 | 0 | 0 | 17 | 24 | 35 |
| 37 | Lotissement Djily Mbaye | 60 | 184 | 405 | 0 | 0 | 0 | 60 | 184 | 405 |
| 38 | Cite Diamalaye | 423 | 513 | 667 | 0 | 0 | 0 | 423 | 513 | 667 |
| 39 | Cimetiere | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 39 b | Cite BCEAO (cadres) | 11 | 34 | 75 | 0 | 0 | 0 | 11 | 34 | 75 |
| 40 | H.L.M. Grand Medine | 86 | 113 | 159 | 0 | 0 | 0 | 86 | 113 | 159 |
| 41 | Stade Amitie | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 2 |
| 42 | Grand Medine | 758 | 887 | 1,103 | 0 | 0 | 0 | 758 | 887 | 1,103 |
| 43 | H.L.M. Grand Yoff/Khar Yalla | 223 | 286 | 395 | 0 | 0 | 0 | 223 | 286 | 395 |
| 43 b | SCAT-URBAM | 652 | 1,985 | 4,373 | 0 | 0 | 0 | 652 | 1,985 | 4,373 |
| 44 | H.L.M. Patte d'Oie | 312 | 379 | 492 | 0 | 0 | 0 | 312 | 379 | 492 |
| 45 | Grand Yoff/Khar Yalla | 1,980 | 2,873 | 4,438 | 0 | 0 | 0 | 1,980 | 2,873 | 4,438 |
| 82 | Equipements (CEREEQ) | 5 | 5 | 6 | 0 | 0 | 0 | 5 | 5 | 6 |
| 83 | Habitat Grand Standing | 58 | 77 | 110 | 0 | 0 | 0 | 58 | 77 | 110 |
| 84 | Prison Fort B | 9 | 10 | 12 | 0 | 0 | 0 | 9 | 10 | 12 |
| 85 | Parc Zoologique, ISRA | 47 | 52 | 60 | 0 | 0 | 0 | 47 | 52 | 60 |
| 86 | Cite Ady Niang | 75 | 131 | 232 | 0 | 0 | 0 | 75 | 131 | 232 |
| 87 | Equip. SENELEC Ecole | 12 | 13 | 15 | 0 | 0 | 0 | 12 | 13 | 15 |
| 88 | Petite Cite | 4 | 14 | 30 | 0 | 0 | 0 | 4 | 14 | 30 |
| 89 | SICAP 2 | 0 | 953 | 2,100 | 0 | 0 | 0 | 0 | 953 | 2,100 |
| 98 | Cite Builders | 326 | 413 | 563 | 0 | 0 | 0 | 326 | 413 | 563 |
| 99 | Lotis. Impots et Domaine | 163 | 244 | 386 | 0 | 0 | 0 | 163 | 244 | 386 |
| 100 | SOPRIM | 113 | 137 | 178 | 0 | 0 | 0 | 113 | 137 | 178 |
| 101 | Parcelles Assainies | 5,824 | 8,039 | 11,906 | 0 | 0 | 0 | 5,824 | 8,039 | 11,906 |
| 90 | Dalifort | 366 | 457 | 615 | 0 | 0 | 0 | 366 | 457 | 615 |
| 91 | HACIENDA | 27 | 36 | 51 | 0 | 0 | 0 | 27 | 36 | 51 |
| 94 | Cite Faycal | 19 | 34 | 61 | 0 | 0 | 0 | 19 | 34 | 61 |
| 94 b | TECHNOPOLE | 0 | 182 | 368 | 0 | 519 | 1,283 | 0 | 701 | 1,651 |
| 95 | St. de Epuration Camberene | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 96 | Ecole d'Horticulture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 97 | Direction Espaces Verts | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 103 | Lotissements en Cours | 26 | 78 | 171 | 0 | 0 | 0 | 26 | 78 | 171 |
| 104 | Lotissements en Cours | 53 | 161 | 356 | 0 | 0 | 0 | 53 | 161 | 356 |
| 104 b | CADMI | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 104 t | Marche aux Poissons | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 105 | HAMO | 212 | 266 | 357 | 0 | 0 | 0 | 212 | 266 | 357 |
| 111 | Pikine Regulier | 4,009 | 5,615 | 8,424 | 0 | 0 | 0 | 4,009 | 5,615 | 8,424 |
| 112 | Cite Lobatt Fall | 36 | 54 | 85 | 0 | 0 | 0 | 36 | 54 | 85 |
| 113 | Gare Routiere | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 114 | Cite ICOTAF | 2 | 3 | 4 | 528 | 528 | 528 | 530 | 531 | 532 |
| 119 | Guinaw Rail | 2,251 | 2,815 | 3,783 | 0 | 0 | 0 | 2,251 | 2,815 | 3,783 |
| 120 | Equip. SOTRAC, OPCE, SO | 0 | 0 | 0 | 577 | 577 | 577 | 577 | 577 | 577 |
| 128 | Pikine Irregulire, Thiaroye | 4,639 | 6,159 | 8,797 | 0 | 0 | 0 | 4,639 | 6,159 | 8,797 |
| | sub-total | 23,034 | 33,540 | 51,261 | 1,105 | 1,624 | 2,388 | 24,139 | 35,164 | 53,649 |
| 9 | Cite ASECNA | 71 | 96 | 139 | 0 | 0 | 0 | 71 | 96 | 139 |
| 10 | Cite Assemblee | 184 | 249 | 360 | 0 | 0 | 0 | 184 | 249 | 360 |
| 11 | Cite ASECNA (habitat eco.) | 90 | 121 | 176 | 0 | 0 | 0 | 90 | 121 | 176 |
| 12 | Equipements | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 2 |
| 13 | Equipements (elavage) | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 1 | 2 |
| 14 | Cite ASECNA (cadres) | 41 | 62 | 100 | 0 | 0 | 0 | 41 | 62 | 100 |
| 15 | Terrain de Sports | 2 | 3 | 3 | 0 | 0 | 0 | 2 | 3 | 3 |
| 16 | Zone mil. Camp ARCHIN | 9 | 10 | 12 | 0 | 0 | 0 | 9 | 10 | 12 |
| 17 | Village de Ouakam | 1,044 | 1,467 | 2,206 | 0 | 0 | 0 | 1,044 | 1,467 | 2,206 |
| 18 | Base Aerienne Terme Sud | 5 | 5 | 6 | 0 | 0 | 0 | 5 | 5 | 6 |
| 19 | Cite des Douanes | 414 | 577 | 861 | 0 | 0 | 0 | 414 | 577 | 861 |
| 20 | Quartir Touba Ouakam | 502 | 666 | 953 | 0 | 0 | 0 | 502 | 666 | 953 |
| 21 | Ter. Mil. Ecole Gendarmerie | 47 | 52 | 60 | 0 | 0 | 0 | 47 | 52 | 60 |
| 22 | Equipements | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | Cite Africa | 72 | 107 | 169 | 0 | 0 | 0 | 72 | 107 | 169 |
| | sub-total | 2,483 | 3,417 | 5,049 | 0 | 0 | 0 | 2,483 | 3,417 | 5,049 |

# TABLE B.2.6 (3) POLLUTION LOAD PRODUCED (BOD) (3)

(unit :kg/day) (3/3)

| No. | Unit Name | Domes. BOD Load (kg/day) | | | Indus. BOD Load (kg/d) | | | Total BOD Producted (kg/d) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 | 1993 | 2000 | 2010 |
| 106 | Equipement Militaire | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 107 | Lotissement Golf Nord | 20 | 40 | 77 | 0 | 0 | 0 | 20 | 40 | 77 |
| 108 | Terrain de Golf | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 108 b | Cite Golf Sud | 589 | 736 | 989 | 0 | 0 | 0 | 589 | 736 | 989 |
| 109 | Cite Adama Diop HAMO | 215 | 269 | 362 | 0 | 0 | 0 | 215 | 269 | 362 |
| 109 b | H.L.M. Guediawaye | 443 | 554 | 744 | 0 | 0 | 0 | 443 | 554 | 744 |
| 110 | Niayes | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 112 b | Cite SOTIBA | 137 | 171 | 230 | 0 | 0 | 0 | 137 | 171 | 230 |
| 129 | Pikine Guediawaye | 6,184 | 8,735 | 13,199 | 0 | 0 | 0 | 6,184 | 8,735 | 13,199 |
| 130 | Cite HAMO | 83 | 103 | 139 | 0 | 0 | 0 | 83 | 103 | 139 |
| 130 b | Cite Adama Diop/Barry | 68 | 85 | 114 | 0 | 0 | 0 | 68 | 85 | 114 |
| 131 | Golf Guediawaye | 214 | 291 | 424 | 0 | 0 | 0 | 214 | 291 | 424 |
| 132 | Lotissement | 33 | 101 | 222 | 0 | 0 | 0 | 33 | 101 | 222 |
| 133 | Lotissement en Cours | 23 | 70 | 154 | 0 | 0 | 0 | 23 | 70 | 154 |
| 134 | Lotissment | 37 | 112 | 248 | 0 | 0 | 0 | 37 | 112 | 248 |
| | sub-total | 8,046 | 11,267 | 16,902 | 0 | 0 | 0 | 8,046 | 11,267 | 16,902 |
| 121 | Camp Militaire Faidherbe | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 121 b | Redevelopment of 121, 81.6 ha | 2,350 | 2,600 | 3,000 | 0 | 0 | 0 | 2,350 | 2,600 | 3,000 |
| 124 | Cite Tivaoune | 473 | 592 | 795 | 0 | 0 | 0 | 473 | 592 | 795 |
| 125 | Diaksao 1 | 772 | 965 | 1,297 | 0 | 0 | 0 | 772 | 965 | 1,297 |
| 126 | Diaksao 2 | 1,219 | 1,524 | 2,048 | 0 | 0 | 0 | 1,219 | 1,524 | 2,048 |
| 127 | Lotissement Rochette | 48 | 86 | 153 | 0 | 0 | 0 | 48 | 86 | 153 |
| 135 | Centre Transmission As | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 136 | Centre Transmission Ar | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 137 | Village de Malika | 854 | 1,195 | 1,793 | 0 | 0 | 0 | 854 | 1,195 | 1,793 |
| 138 | Extension Village de Malika | 461 | 577 | 775 | 0 | 0 | 0 | 461 | 577 | 775 |
| 139 | Centre Emetteur SONATEL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 140 | Village de Keur Massar | 136 | 271 | 513 | 0 | 0 | 0 | 136 | 271 | 513 |
| 141 | Village Keur Abdou | 124 | 166 | 239 | 0 | 0 | 0 | 124 | 166 | 239 |
| 142 | Centre Evangelique | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 142 b | Parcelles Assainies de Malika | 0 | 3,541 | 7,800 | 0 | 0 | 0 | 0 | 3,541 | 7,800 |
| 143 | Village de Yeumbeul | 3,889 | 6,874 | 12,171 | 0 | 0 | 0 | 3,889 | 6,874 | 12,171 |
| 144 | Village de Boune | 145 | 194 | 280 | 0 | 0 | 0 | 145 | 194 | 280 |
| 145 | SICAP Mbao | 134 | 270 | 513 | 0 | 0 | 0 | 134 | 270 | 513 |
| 146 | Foirail | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 147 | Fass Mbao | 205 | 346 | 595 | 0 | 0 | 0 | 205 | 346 | 595 |
| 148 | Diamaguene. | 1,987 | 2,636 | 3,764 | 0 | 0 | 0 | 1,987 | 2,636 | 3,764 |
| 149 | Cite SABE | 21 | 27 | 38 | 0 | 0 | 0 | 21 | 27 | 38 |
| 150 | LGI (Gendarmerie) | 24 | 26 | 30 | 0 | 0 | 0 | 24 | 26 | 30 |
| 151 | Centre Institut Pasteur | 2 | 3 | 3 | 0 | 0 | 0 | 2 | 3 | 3 |
| 152 | Cite Gueye | 37 | 47 | 65 | 0 | 0 | 0 | 37 | 47 | 65 |
| 154 | Village Mbao Goundao | 133 | 166 | 223 | 0 | 0 | 0 | 133 | 166 | 223 |
| 155 | Village Grand Mbao | 297 | 384 | 533 | 0 | 0 | 0 | 297 | 384 | 533 |
| 156 | Centre National d'Aviculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 157 | Village de Kamb Goundao | 184 | 246 | 356 | 0 | 0 | 0 | 184 | 246 | 356 |
| 158 | Foret Classee de Mbao | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | sub-total | 13,495 | 22,736 | 36,984 | 0 | 0 | 0 | 13,495 | 22,736 | 36,984 |
| 1 | Equip. Tourist. Almadies | 141 | 156 | 180 | 0 | 0 | 0 | 141 | 156 | 180 |
| 2 | OCI | 5 | 5 | 6 | 0 | 0 | 0 | 5 | 5 | 6 |
| 3 | Remembrement Almadies | 271 | 596 | 1,176 | 0 | 0 | 0 | 271 | 596 | 1,176 |
| 4 | Village de Ngor | 348 | 458 | 648 | 0 | 0 | 0 | 348 | 458 | 648 |
| 5 | Zone Touristique Ngor | 118 | 130 | 150 | 0 | 0 | 0 | 118 | 130 | 150 |
| 6 | Habitat Grand Standing Ngor | 15 | 31 | 59 | 0 | 0 | 0 | 15 | 31 | 59 |
| 7 | Ranrhar | 367 | 516 | 776 | 0 | 0 | 0 | 367 | 516 | 776 |
| 7 b | Village de Yoff | 1,693 | 2,416 | 3,683 | 0 | 0 | 0 | 1,693 | 2,416 | 3,683 |
| 8 | Aeroport | 24 | 26 | 30 | 0 | 0 | 0 | 24 | 26 | 30 |
| 102 | Village de Camberene | 1,110 | 1,442 | 2,017 | 0 | 0 | 0 | 1,110 | 1,442 | 2,017 |
| | sub-total | 4,092 | 5,776 | 8,725 | 0 | 0 | 0 | 4,092 | 5,776 | 8,725 |
| 159 | Zone Speciale de Mbao Gare | 0 | 7,155 | 15,756 | 0 | 0 | 0 | 0 | 7,155 | 15,756 |
| | Grand Total | 76,808 | 117,437 | 181,899 | 11,751 | 17,512 | 25,680 | 88,559 | 134,949 | 207,579 |

Source : Study Team

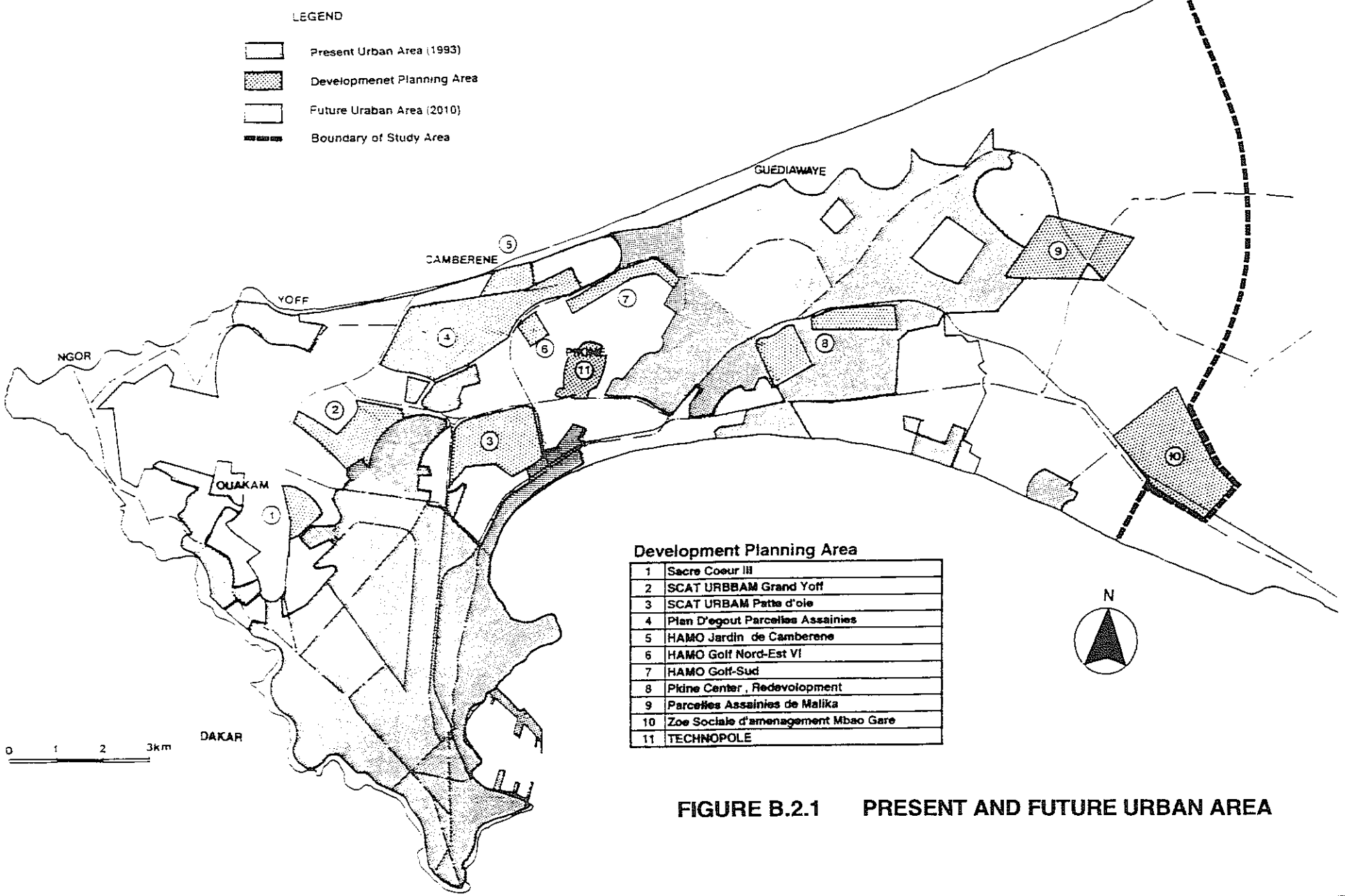
## TABLE B.2.7 FLOW RATES TO CAMBERENE WASTEWATER TREATMENT PLANT

| Time | Inflow (cu.m/hr) | Ratio (Inflow/av.) |
|---|---|---|
| 6:00 | 168 | 0.85 |
| 8:00 | 211 | 1.07 |
| 10:00 | 379 | 1.92 |
| 12:00 | 295 | 1.50 |
| 14:00 | 211 | 1.07 |
| 16:00 | 253 | 1.28 |
| 18:00 | 168 | 0.85 |
| 20:00 | 211 | 1.07 |
| 22:00 | 168 | 0.85 |
| 24:00 | 126 | 0.64 |
| 2:00 | 42 | 0.21 |
| 4:00 | 126 | 0.64 |
| Average | 197 | 1.00 |

Source : SONEES

## TABLE B.2.8 CLASSIFICATION AND CHARACTERISTICS OF ON-SITE SYSTEM

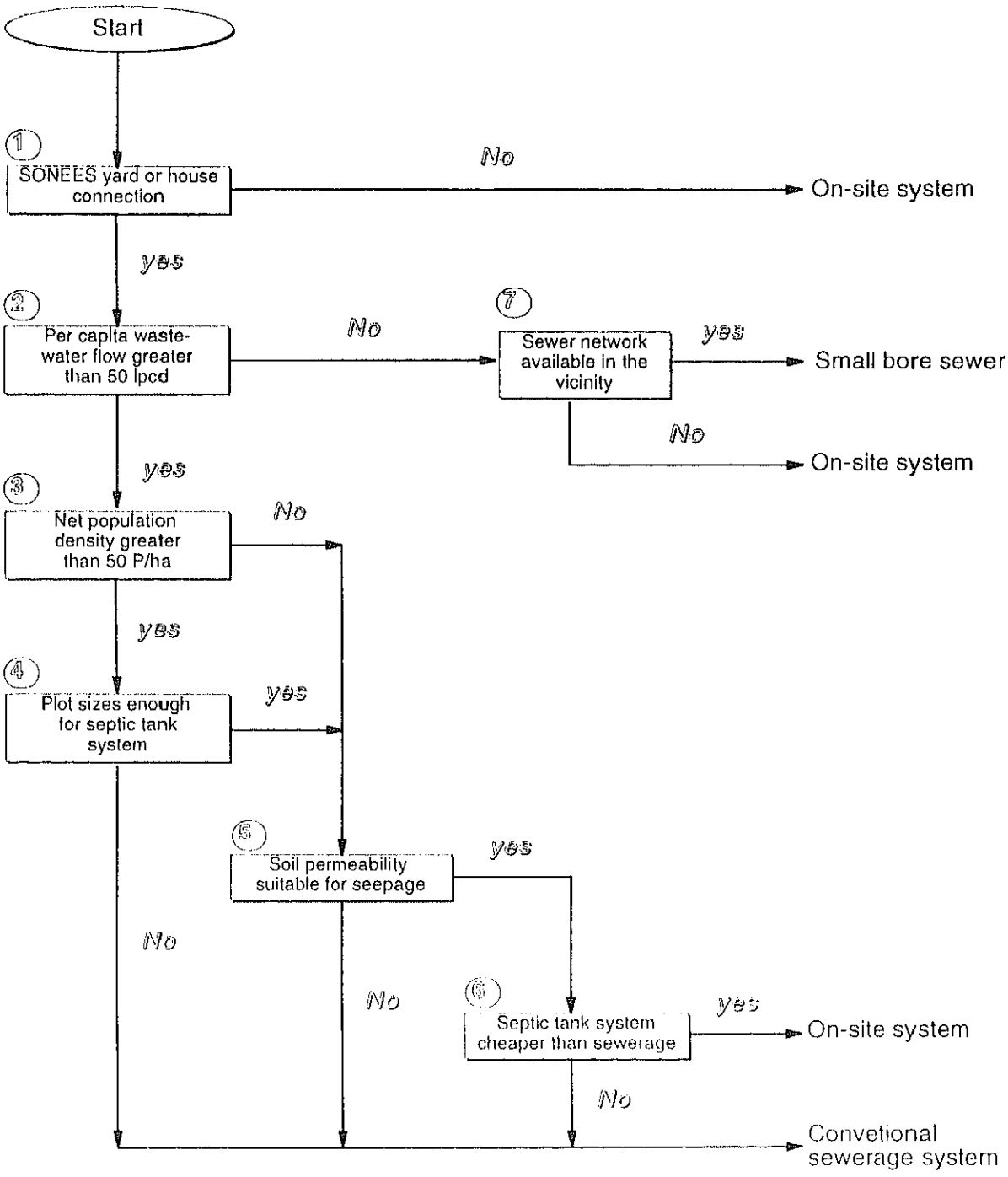
| TREATMENT METHOD | WASTEWATER | DISPOSAL METHOD | POSSIBLE EFFECTS TO ENVIRONMENT |
|---|---|---|---|
| NON | TOILET WASTE | DISCHARGE | BACTERIOLOGICAL CONTAMINATION, SEVERE WATER POLLUTION |
| | | INFILTRATION | BACTERIOLOGICAL CONTAMINATION OF GROUND WATER |
| | | COLLECTION | DEPENDING ON TREATMENT / DISPOSAL OF COLLECTED WASTE |
| SEPTIC TANK | TOILET WASTE | DISCHARGE | LESS BACTERIOLOGICAL CONTAMINATION AND WATER POLLUTION |
| | | INFILTRATION | HIGH DENSITY INFILTRATION MAY CASE GROUNDWATER CONTAMINATION (NITROGEN) |
| AEROBIC BIOLOGICAL TREATMENT (ACTIVATED SLUDGE / FILTRATION BED) | ALL WASTEWATER | DISCHARGE | EFFECTS TO ENVIRONMENT MAY BE AS SAME LEVEL AS THAT OF SEWAGE TREATMENT IN SEWERAGE SYSTEM AS LONG AS OPERATION / MAINTENANCE BEING MAINTAINED NORMAL |
| | | INFILTRATION | POSSIBILITY OF GROUNDWATER CONTAMINATION IS ALMOST ELIMINATED EXCEPT NITROGEN CONTAMINATION |




**Development Planning Area**

| | |
|---|---|
| 1 | Sacre Coeur III |
| 2 | SCAT URBBAM Grand Yoff |
| 3 | SCAT URBAM Patte d'oie |
| 4 | Plan D'egout Parcelles Assainies |
| 5 | HAMO Jardin de Camberene |
| 6 | HAMO Golf Nord-Est VI |
| 7 | HAMO Golf-Sud |
| 8 | Pkine Center , Redevolopment |
| 9 | Parcelles Assainies de Malika |
| 10 | Zoe Sociale d'amenagement Mbao Gare |
| 11 | TECHNOPOLE |

**FIGURE B.2.1 PRESENT AND FUTURE URBAN AREA**




Note: Appropriate on-site systems are not specified

**FIGURE B.2.2 SELECTION OF SANITARY SYSTEMS**

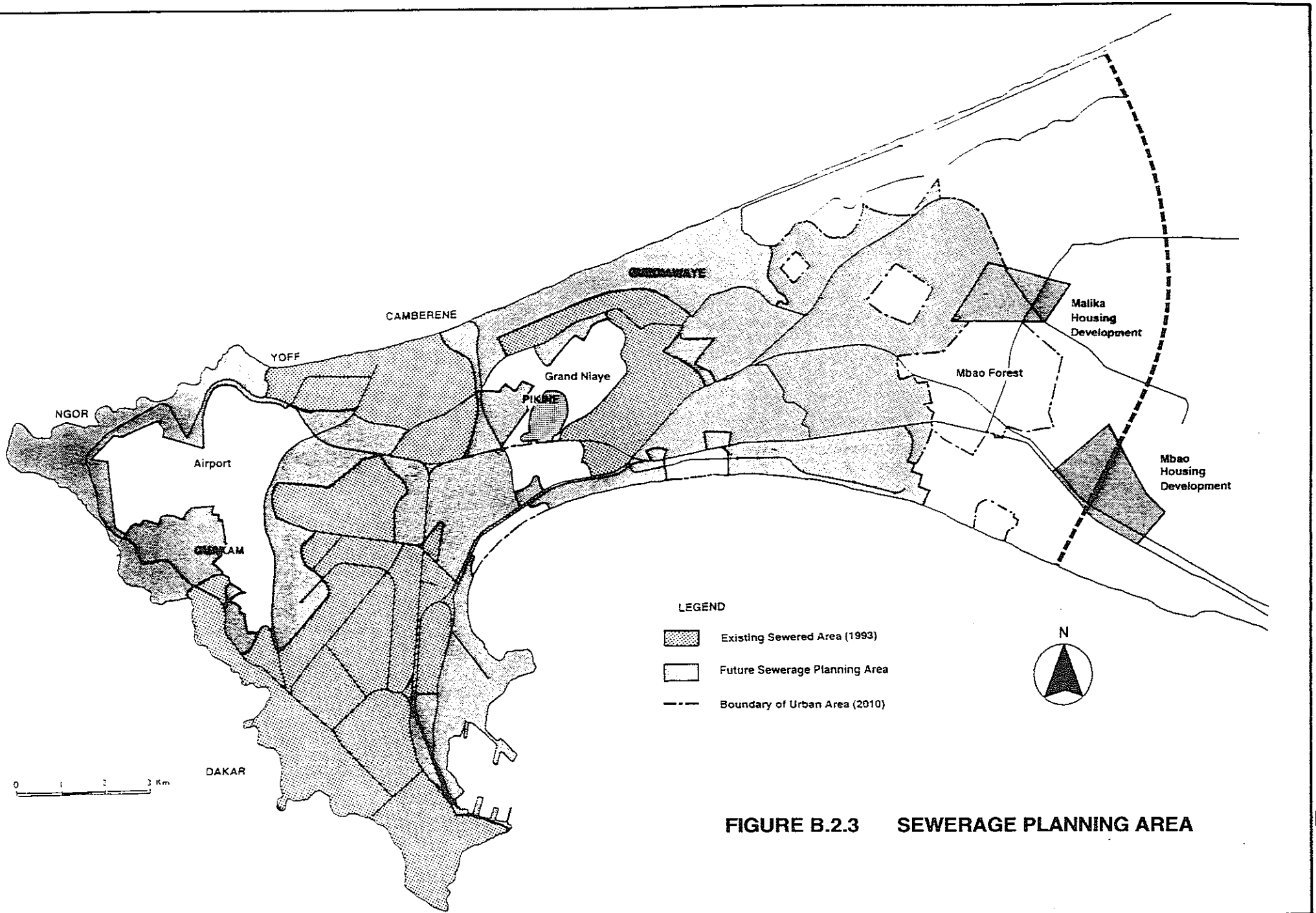



**FIGURE B.2.3 SEWERAGE PLANNING AREA**

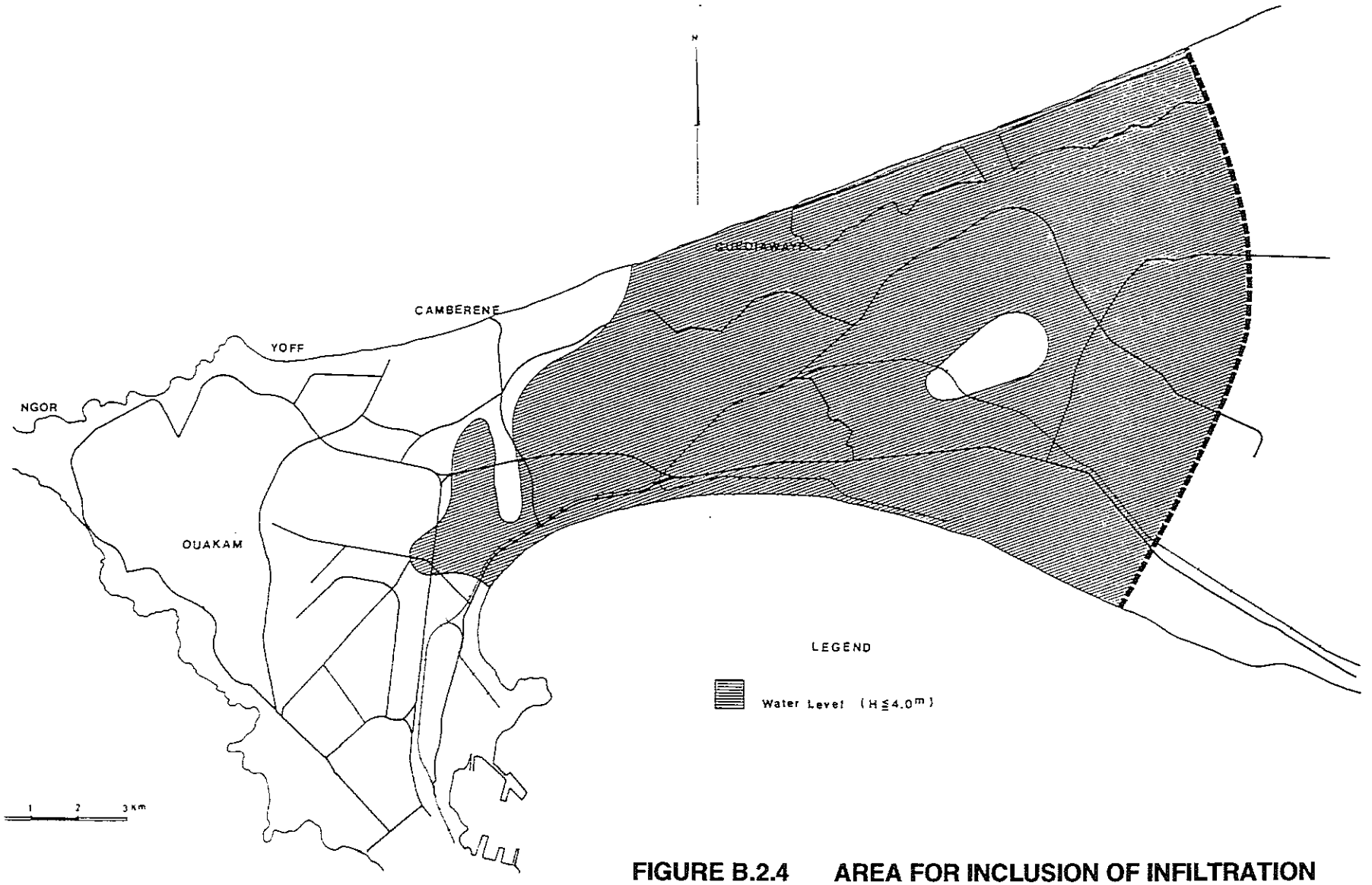



**FIGURE B.2.4 AREA FOR INCLUSION OF INFILTRATION**

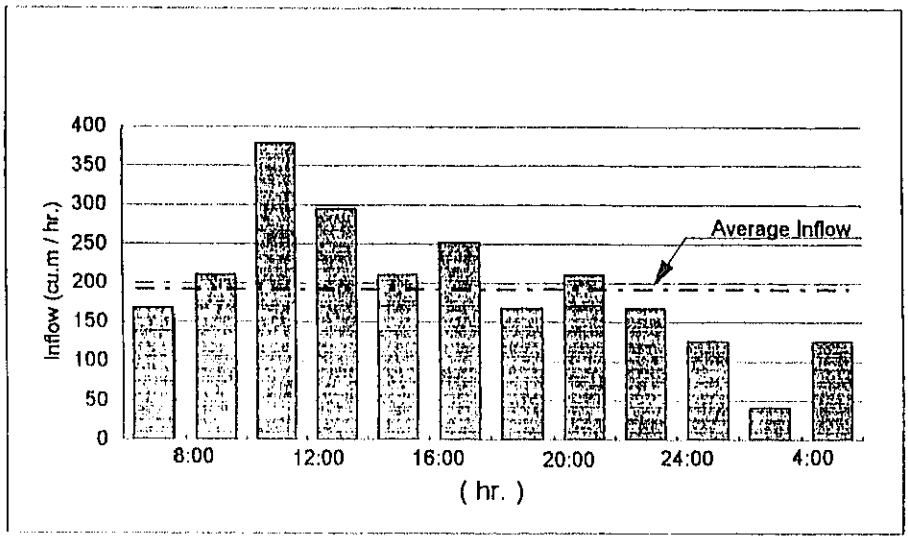



**FIGURE B.2.5 FLOW RATES TO CAMBERENE WWTP**

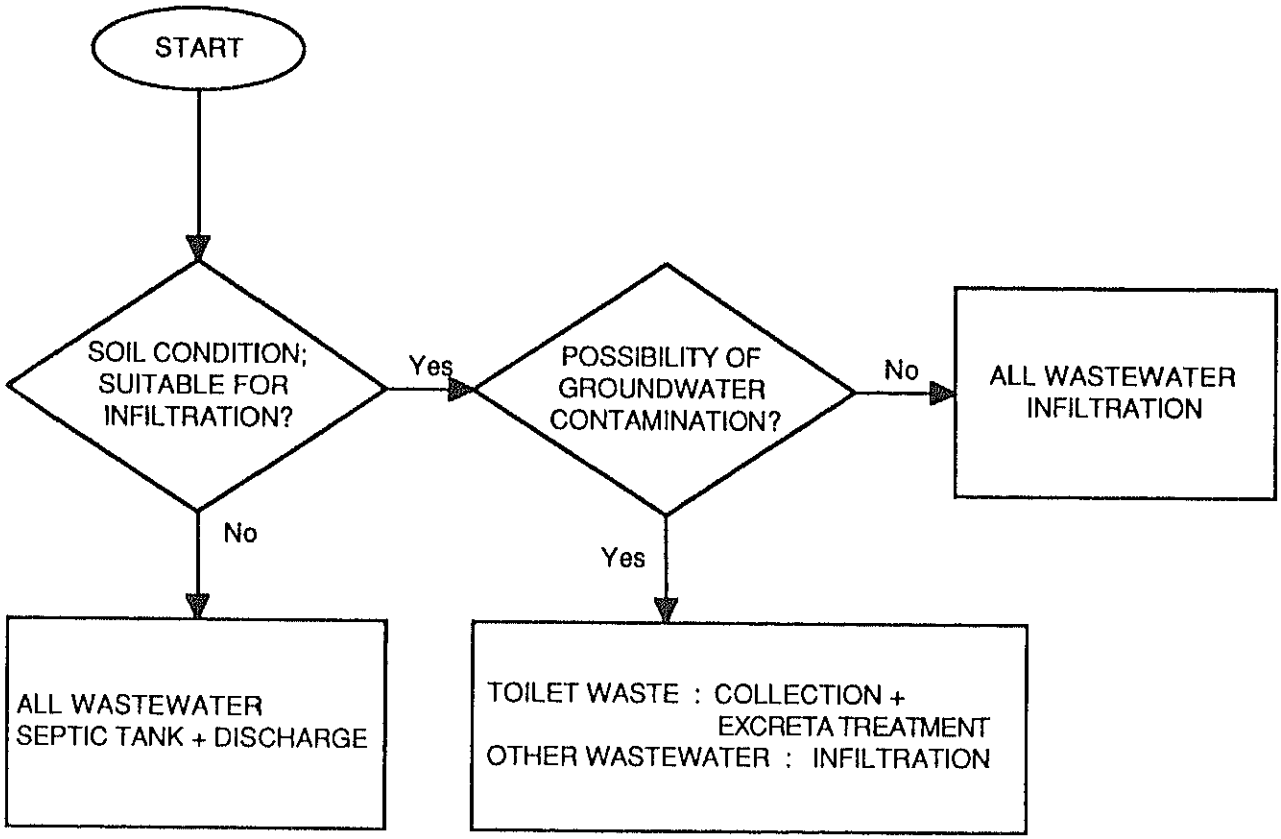



**FIGURE B.2.6 FLOW CHART FOR SELECTION OF ON-SITE TREATMENT**