PART II FEASIBILITY STUDY

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CHAPTER 1. INTRODUCTION

1.1 Introduction

As discussed in Master Plan, the following two priority projects have been selected for the Feasibility Study among the structural components in the Master Plan focusing on sewerage and sanitation improvement as well as stormwater drainage management for the target year of 2020.

(1) Sewage and sanitation improvement: The target structural components are the rehabilitation of existing lagoon, construction of new aerated lagoon and septage treatment plant, related rehabilitation of sewer pipes and construction of new trunk sewer, construction of new 3 pumping stations and rehabilitation of 2 existing pumping stations.

(2) Stormwater drainage management: The target structural components are construction of drains, pumping stations and retention pond excluding the northeastern part of drains in the north drainage area.

In this part of the report, the Feasibility Study is conducted especially in consideration of technical, financial, institutional and environmental points of views.

CHAPTER 2. ORGANIZATIONAL SETUP FOR PROJECT IMPLEMENTATION

2.1 Organizations/Actors Related to the Project

A lot of organizations are involved in the Project which aims to improve environmental and sanitary conditions in Kaolack City. These are mainly: Ministry of Hydraulics and Sanitation, Kaolack City, governmental agencies and urban development entities attached to the ministries. Non-governmental organizations as well as community-based organizations are also in the field.

2.1.1 Ministries and Agencies in the National Level

Ministries and agencies related to the Project in the national level are as summarized below.

(1) Ministry of Hydraulics and Sanitation

Department of Urban Sanitation: This department is in charge of planning and monitoring studies and the implementation of urban sanitation programs in collaboration with ONAS (mentioned below).

ONAS: It is a public establishment, which is industrial and commercial in nature, in charge of sanitation management. It was created by Law No. 96-02 of 22 February 1996. As the representative of the Department of Urban Sanitation, it manages the collective sanitation sewerage, the wastewater treatment plant and the pumping stations in Kaolack City.

SONES and SDE: SONES (National Water Company of Senegal) is the state asset holding company of water supply system and SDE (Senegalese Water) is the private operating company responsible for the production and distribution of drinking water in the major cities and towns of the country. SONES is in charge of investments in infrastructure, and regulation of SDE. SDE is responsible for operation, regular maintenance, some investments for system expansion, as well as billing and collection.

(2) Ministry of Environment and Sustainable Development

APROSEN: It was a public entity endowed with management autonomy and vested with a public service mission for solid waste management. APROSEN offered a technical and material support to local governments for solid waste management. It was dissolved and its mission was transferred to UCG in 2012.

DEEC (Department of Environment and Classified Establishments): It is responsible mainly for (1) prevention and control of pollutions and nuisances; (2) monitoring activities of various entities and organizations which are affecting the environment; (3) drawing up legal instruments concerning environment; (4) checking / monitoring conformity in environmental management of projects; and (5) validating the SEA report in the Technical Committee for EIA validation.

(3) Ministry of Urban Development and Housing

Department of Urban Development and Architecture: It conducts investigations and issues papers regarding urban planning, supports local governments in drawing up the Master Plan of urban development, and controls urban planning as well as the formulation of building and architecture standards.

(4) Ministry of Regional Planning and Local Governments

UCG (Solid Waste Management and Coordination Unit): It was established in 2011 and assumed tentatively, the mission of APROSEN in 2012 for the transition period until the new entity is established. Since PNGD was officially established in July 2013, the mission regarding solid waste management will be transferred to PNGD, and UCG will be integrated to PNGD as its administrative unit.

PNGD (National Program for Solid Waste Management): Its goal is to support local governments for the improvement of their solid waste management. Its mission includes (1) the revision of laws

and regulations of the sector; (2) the realization of waste management infrastructure development; (3) the reduction of illegal damping; (4) the provision of technical and financial support to local governments; (5) dissemination and capacity development; and (6) coordination, monitoring and evaluation of programs.

(5) Ministry of Restructuring and Development of Inundation Areas

PCLSLB (Project of Social Housing and Slum Prevention): It was originally established on June 19, 2006 as a solution to inundation and to provide relief to flood victims by relocating them to safe places and providing them with houses and necessary infrastructures. So far, it has provided accommodation for about 2,000 out of about 5,000 households which lost houses by floods. Presently, it has no relocation plan for Kaolack City.

(6) Non-Profit Organizations for Development

ADM (Municipal Development Agency): It is an association of private non-profit organizations which was created in 1997. Its mission is to undertake activities that will ensure a better management of municipal development on the contract basis. If needs a financing source, ADM helps the municipalities in securing financial sources for municipal development.

AGETIP (Public Works and Employment Agency): It is not a public entity, but a private non-profit entity that is financed entirely by fees for the services it provides without receiving government or donor funds to cover its administrative expenses. It provides mostly small-scale basic infrastructure services (roads, water supply, sanitation, health centers, hospitals, schools etc.) which involve multiple sector organizations.

2.1.2 Related Organizations/Actors at Regional Level

Organizations/actors at the regional level related to the Project are as summarized below.

(1) Governor of Kaolack Region

The Governor is the representative of the President of the Republic at the regional level. Thus, he is responsible for the enforcement of laws and rules. He receives from the President and the government members, guidance and instruction regarding the national policy. He coordinates regional and local civil service actions. He is responsible for the economic and social development of the Region.

In terms of environment, the Governor chairs the Regional Environmental Monitoring Committee of Development Projects and all advisory committees set up at the regional level, as a general rule. He approves the Regional Environmental Action Plan and the Regional Land Planning Scheme. He also participates in the development and implementation of resettlement plans, as the President of the Regional Land Valuation Committee.

(2) Prefect of Kaolack Department

The Prefect coordinates the activities of all public services in the Department. He checks legal conformity of the activities of the Mayor and the City Council, and also approves the activities that the City Government takes in certain fields. Thus, in accordance with the Sanitation Code, the Prefect is responsible for the approval of the Master Plan of sanitation for the management of sewage and stormwater in Kaolack Department. He also directly intervenes in the implementation of resettlement plans.

(3) Regional Department of Environment and Classified Establishments (DREEC) of Kaolack

DREEC is composed of five agents including the Head of the Division and his assistant. It plays the role as Secretariat of the Regional Environmental Monitoring Committee of Development Projects. The DREEC of Kaolack also collaborates with the City Council of Kaolack to which it gives technical support.

(4) Regional Sanitation Service (SRA) of Kaolack

In urban areas, SRA supervises the regional service of ONAS which is the operational organization. However, the collaboration between these entities is not necessarily effective because ONAS is highly autonomous, owing to its status as a public establishment of industrial and commercial in nature.

(5) Regional Delegation of APROSEN

APROSEN offers technical and material support to the City Council of Kaolack which is the authority on solid waste management. Since APROSEN was dissolved in 2012, UCG assumed its mission but UCG have not located regional representatives.

(6) Regional Department of Town Planning and Architecture

Its missions are, among others, conducting and issuing town planning papers, supporting local governments in drawing up their master plan for urban development, and controlling urban planning as well as formulating building and architectural standards as the regional representative of the Ministry of Urban Development and Housing.

(7) Regional Service of Regional Planning

It is responsible for the coordination and implementation of regional plans as the regional representative of the Ministry of Regional Planning and Local Governments.

(8) Regional Hygiene Service

Its missions are concerned with: the application of the Hygiene Code, activities of prevention and awareness-raising on hygiene, training of extension agents in waste management as a regional representative of the Ministry of Hydraulics and Sanitation.

(9) Regional Environmental Monitoring Committee of Development Projects

The Governor of Kaolack Region set up the Regional Environmental Monitoring Committee of Development Projects, by the Order of 13 August 2010. The Committee is personally chaired by the Governor, and the head of the DREEC is in charge of the Secretariat. The Committee includes all regional technical services concerning environmental issues. It holds a meeting whenever needed upon the Governor's notification, and can invite any person whose competence is judged relevant to the project implementation.

(10) Regional Development Committee (CRD)

Chaired by the Governor of the Region, the Regional Development Committee is the consultation, coordination and grass-root participation framework. It coordinates the representatives of devolvement service agencies, NGOs and development projects affecting the area.

2.1.3 Related Organizations/Actors at City and Local Community Level

Organizations/actors related to the Project at the City level are summarized as follows.

(1) Mayor and City Government

The Mayor has municipal police powers and is in charge of order, safety, security and public health. Regarding planning, the City Government draws up and carry out the Local Investment Plan and the Local Action Plan for Environment, which is a reference framework allowing the integration of environment in the municipal development process. The management of solid waste produced within the area falls within the responsibility of the City Government, which shall ensure the collection, transport, storage, treatment or disposal thereof. It can delegate the operation by contract with private operators.

Organizations related to the projects under the City Government include the City Council, the Engineering Service, the Secretary-General, the Environmental Commission and the Sanitation Commission.

(2) NGOs and Community-Based Organizations

In the project area there are a few NGOs and community-based organizations (CBOs) with a strong field experience in sanitation in the sphere of local development. Such experienced NGOs and CBOs include CARITAS, ASDES and CODEKA (Committee for Kaolack Development) in the sector of solid waste management, for example. They can be senior partners in program implementation.

2.2 Capacity Assessment of Organizations/Actors

2.2.1 Background

The capacity assessment was held as a part of the public consultation in SEA, based on open and/or semi-structured interviews using a checklist. These interviews have helped ensure a thorough exploration of key sanitation issues. The purpose of those open interviews was, among others, to collect opinions, concerns and recommendations related to various adverse impacts generated by the project. The guide is designed as to allow a more or less free expression of respondents. The structured interviews focused on more technical concerns.

Interviews focused on the following themes:

- Understanding of the project;
- Issues and concerns raised by the project;
- Expectations and recommendations on the project;
- Stakes of each component;
- Gained and capitalized experiences; and
- Potential technical, institutional and financial constraints (coordination, organization and capacity).

Interviews took place from 2 to 5 and from 7 to 12 of May 2012 in Kaolack and Dakar.

2.2.2 Results of Capacity Assessment

Results of the capacity assessment are as summarized below.

- The governmental administration is the institutional supervising body of the Steering Committee and consultation frameworks. As such, it deserves to benefit from capacity building in environmental management;
- Regional delegates of ministries/agencies have a strong experience in sanitation, but human, financial and material resources are still limited;
- The local governments have at their disposal services and comparatively enough employees but their execution capacity is still small and therefore, there is a need for capacity building in logistics, technique and organization; and
- NGOs and CBOs have developed a significant experience and expertise, but they still have a limited execution capacity because their budgets are small.

Detailed results are shown in the following table.

Table 2.2.1 Results of Capacity Assessment

Organization/Actor	Strength	Weakness	Needs in Capacity Building
Kaolack Region / Kaolack Department	• Hierarchic power on administration • Institutional supervision of the consultation frameworks and experience of Steering Committee on sanitation issues	• Insufficient human resources • Inadequate coordination among various devolvement services	• Training of administrative authorities on competences in the field of environment and sanitation

Organization/Actor	Strength	Weakness	Needs in Capacity Building
Kaolack City Government	• Existence of a Department of Engineering Services • Existence of a solid waste management plan • Existence of a municipal landfill and transfer sites • Existence of ROC pre-collection system	• Limited executing capacity • Insufficient budget • Low revenue from the charges on household waste removal • Insufficient logistics • Human resources not qualified enough • Land insecurity and lack of delineation of the dump site	• Training and provision of technical service staffs for solid waste management and rainwater drainage • Training City Councilors in city planning, environment and sanitation • Establish of transfer sites • Conversion of the municipal dumping ground into a landfill site • Recovery and extension of the rainwater drainage system • Support for public awareness-raising
ONAS Kaolack	• Existence of expertise and experience • Existence of a collective sewage and treatment plant • Network extension under way with the support of PRECOL	• Low coverage of the collective sewage • No sludge treatment plant • No sanitary disposal of sewage by individuals	• Extension of the collective sewage • Reinforcement of the treatment plant • Construction of a sludge disposal unit • Staff training on environment-friendly sanitation techniques
APROSEN Kaolack (It was dissolved in 2012.)	• Experience and expertise in the field of solid waste management • Advisory support to local authorities	• Human, financial and material resources • Frequent change of the supervisory body	• Strengthening human resources and logistics of APROSEN
DREEC	• Existence of Regional Environmental Monitoring Committee of Development Projects • Application of the Environment Code	• Limited human, financial and material resources • Low level of collaboration with the City Government • Low popularization of the Environment Code • Insufficient control of classified facilities and compliance with discharge standards for sewage	• Capacity Building of human and logistical resources • Strengthening of control of classified facilities • Capacity building of the Regional Environmental Monitoring Committee • Support to the development of hazardous waste management strategy
Regional Hygiene Service	• Qualified and experienced human resources	• Human, financial and material resources	• Strengthening of human resources and logistics
Regional Department of Town Planning and Architecture	• Qualified and experienced human resources	• Human, financial and material resources • Obsolescence of the Master Plan of Urban Development	• Support to the participatory update and extension of the master planning scheme on urban development formulated in 1987
NGOs and CBOs	• Strong experience in social support	• Limited executing capacity • Limited budget	• Technical and financial support • Appropriate equipment

Source: Final Report of Strategic Environmental Assessment for the Project for Treatment of Sewage, Rainwater and Wastes in Kaolack City, December 2012

2.3 Organizational Setup for Project Implementation

According to the results of examination on the organizations/actors related to the Project and consultation with ONAS Kaolack and Kaolack City, the organizational setup for project implementation can be recommended to consist, basically, of a Steering Committee, a Technical Committee, and an Implementation Unit (IU) for each project component, namely; sewerage and stormwater drainage. A third IU shall be added to this setup when the solid waste management component is started. The formulation of the organizational setup is shown below.

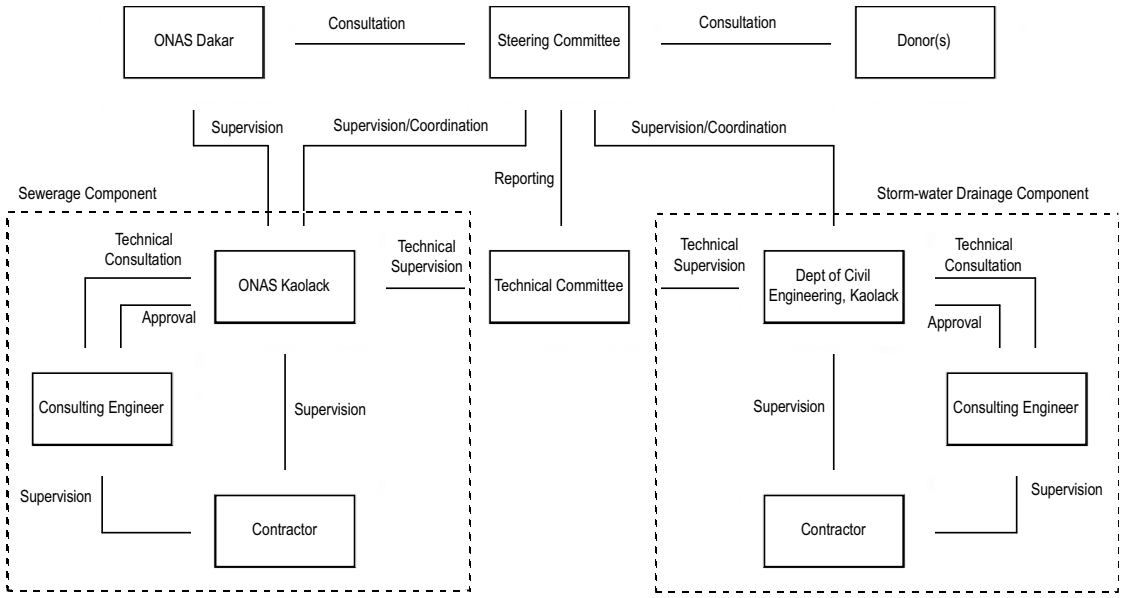


Fig. 2.3.1 Organizational Setup for Project Implementation

(1) Steering Committee

The Steering Committee (SC) is chaired by the Governor of the Kaolack Region to ensure a higher level of coordination and policy support. It comprises representatives of the related agencies in charge of urban development, sanitation, environment and local government. The SC is responsible for providing overall project oversight, ensuring policy support, strategic planning and coordination with other urban development programs. Other experts may be invited to attend the SC meetings as required. The SC will meet once a month and on an ad hoc basis when required. To facilitate the work of the SC, ONAS Kaolack will function as the Secretariat.

The members of SC are:

1) Administrative Hierarchy

- Governor (Chairperson)
- Prefect of Kaolack Department

2) Kaolack City

- Assistant Mayor
- President of Environment Commission
- President of Sanitation Commission
- General Secretary to the Mayor
- Chief of Engineering Department

3) Regional Delegate of Ministry/Agency

- ONAS Kaolack (Secretariat)
- Regional Department of Town Planning and Architecture
- Regional Department of Land-use Planning (This member is required to attend the meetings to coordinate projects which use land or conduct land development.)
- Regional Hygiene Service
- DREEC

4) Non-Profit Organization for Development

- Public Interest Works Execution Agency (AGETIP)
- Municipal Development Agency (ADM)

5) Others

Other experts including NGOs and CBOs will be invited to attend the meetings as required.

6) Representative(s) from Donor(s)

(2) Technical Committee

The Technical Committee (TC) will supervise the project from the technical viewpoint and assist SC on technical issues. TC will meet once a month and the results of the meeting are to be reported to SC.

The members of TC are:

- Vice Mayor (Chairperson)
- Department of Civil Engineering, Kaolack
- ONAS Kaolack (Secretariat)
- Regional Department of Town Planning and Architecture
- Regional Department of Land-use Planning (This member is required to attend the meetings to coordinate projects which use land or conduct land development.)
- Regional Hygiene Service
- DREEC
- Others (may be invited to attend the TC meetings as required): Telephone Company (Orange), Water Public Company (SDE), and Electric Power Company (SENELEC)

(3) Implementation Unit for Each Project Component

An Implementation Unit (IU) will be setup for each Project component, namely, sewerage and storm water drainage, at the implementation stage. It will be established in the implementing agencies, namely, ONAS Kaolack and Kaolack City. Both IUs will be supervised by the SC as well as the TC. Detailed tasks of IU should be drafted in the preconstruction stage, considering the actual conditions of implementation. Their outlines are expected as follows:

- To supervise the contractor for the construction of facilities with assistance by the consulting engineer;
- To approve the requests by the consulting engineer;
- To hold IU meetings periodically (i.e. weekly) in order to check the progress of the construction with attendance of the contractor and the consulting engineer; and
- To report to TC and SC and attend the TC and SC meetings.

IUs will be dissolved and staff members are expected to be incorporated into an operation and maintenance team of the implementation agencies after the construction is finished.

CHAPTER 3. SEWERAGE AND SANITATION IMPROVEMENT PLAN

3.1 General

3.1.1 Introduction

As discussed in the Master Plan, sewerage and sanitation facilities in Kaolack City has been constructed in the 1980's but they have seriously deteriorated mainly due to aging and disrepair. In addition, the population projection and wastewater generation by the target year shows rapid urbanization and increase in amount of sewage from the service area. Considering the above conditions, a Feasibility Study has been conducted to improve and expand the sewerage/sanitation system in Kaolack City, focusing on the priority projects proposed in the Master Plan.

3.1.2 Component of Priority Projects

In the Master Plan stage, the area in which sewer network should be expanded for the target year of 2020 is selected from the viewpoints of (i) population/population density, (ii) urgency and (iii) environmental impacts. As a result, sewered area, sewered population and wastewater generated are determined as shown in the following table.

Table 3.1.1 Sewered Area and Population and Wastewater Generated

Items		Unit	Year	
			2020 (Target year of F/S)	2030 (Target year of M/P)
Sewered area	Existing	ha	395	395
	Expansion area	ha	181	942
	Total	ha	576	1,337
Sewered population (Population connected)	Existing	person	39,370	63,230
	Expansion area	person	24,600	188,220
	Total	person	63,970	251,450
Reference (Total population of City Center)		person	314,000	382,000
Wastewater generated	Existing	m^3/day	2,945	5,217
	Expansion area	m^3/day	1,840	15,528
	Total	m^3/day	4,785	20,745

Project components are then selected to accommodate and treat the wastewater generation form the areas. The project components consist of: replacement and new construction of trunk sewer; rehabilitation, replacement and new construction of pumping stations; and rehabilitation and expansion of sewage treatment plant. Quantities and specifications are described in the subsequent subsections.

Branch sewer installation is not among the project components because the Feasibility Study was conducted focusing on the major facilities (trunk sewer, pumping stations and treatment plant), as discussed in the Master Plan. ONAS is responsible for branch sewer installation. Financial support of the brunch sewer installation is envisaged to come from donors such as the WB and/or the Government of Senegal through ADM, which are involved in related sewerage projects in Kaolack.

3.2 Preliminary Design of Sewerage and Sanitation Facilities

3.2.1 General

(1) Target Year

Target year is set at the year of 2020, as discussed in the Master Plan.

(2) Basic Data

The following basic data are employed in the preliminary design.

(a) Topographic Maps

Topographic survey results of cross-sections (ground level) at major points (50 m interval), as well as longitudinal profiles (ground elevation) surveyed, are utilized to set up the longitudinal profile of pipe network and elevation of the facilities.

(b) Soil Conditions

Soil conditions obtained by boring and soil analysis conducted in the Feasibility Study stage, are utilized to design foundations.

(c) References

In principle, design conditions for facilities design are set up following the reports or design example in Kaolack and other cities in Senegal such as Dakar. If the design condition is unclear or unavailable, other reports and/or guidelines are applied, in consultation with ONAS. The design reports used as reference for the Feasibility Study are as enumerated below.

- The Study on Urban Drainage and Wastewater Systems in Dakar City and its surroundings, JICA, 1994
- Urban Storm and Wastewater Sanitation Master Plan in Kaolack, Sanitation Department, Ministry of Hydraulic, 1982
- Guideline for Planning and Design of Sewerage Facilities, Japan Sewage Works Association, 2009
- Domestic Wastewater Treatment in Developing Countries, Duncan Mara
- Wastewater Stabilization Ponds, Principles of Planning & Practice, WHO
- Wastewater Engineering, Treatment and Reuse, Metcalf & Eddy

(3) Capacity Setup of Facilities

Wastewater projection in the Master Plan is employed to set up the capacity of facilities.

3.2.2 Trunk Sewer Network

(1) Design Conditions

Design conditions were set following the design examples in Kaolack or applying the reference materials listed in **Subsection 3.2.1 (c)**.

- Circular pipe is applied with pipe materials of (i) reinforced concrete (diameter of 600 mm or more; (ii) PVC (diameter of less than 600 mm); and (iii) cast iron for force main.
- Minimum covering of 1.0 m is applied in accordance with "Guideline for Planning and Design of Sewerage Facilities, Japan Sewage Works Association, 2009".
- Minimum velocity of 0.6 m/s is set to prevent sedimentation, and maximum velocity of 3.0 m/s is adopted not to damage the pipes.
- Allowance of pipe capacity for design flow is set at (i) more than 100% for pipe diameter of up to 600 mm and (ii) 50% to 100% for pipe diameter of more than 700 mm.
- Direct foundation is, in principle, applied to support sewer pipes.
- Manholes with cast iron covers are installed at such locations as major intersections, points of changing size and/or direction with a maximum interval of 35 m to maintain the pipes and to connect inlet pipes.

(2) Preliminary Design of Trunk Sewer Network

The proposed routes of trunk sewer network are as shown in **Fig. 3.2.1**. Total length of newly constructed and rehabilitated sewer pipe is about 12,863 m and 5,608 m, as shown in the following table. Difference of components (length and size) between Master Plan stage and Feasibility Study stage arise mainly from the results of field and topographical survey conducted in the Feasibility Study stage. Plan and profiles of sewer network, as well as structural drawing of typical manhole,

are shown in "Drawings and Design Notes". The C-19 pipe is not included in the following table because it is not a trunk sewer but the connecting pipe between the existing and expansion areas of STP.

Table 3.2.1 Components of Trunk Sewer Network

Trunk sewer	Size (Diameter)	Length	Remark
New Construction			
A-1	200	543.9	
A-2	200	381.0	
A-3	300	397.0	
A-4	300	494.7	
A-5	200	306.5	
A-6	300	139.6	
B-1	200	155.0	
B-2	200	407.8	
B-3	300	165.0	
B-4	400	685.3	
B-5	200	398.0	
B-6	400	352.3	
B-7	200	320.0	
B-8	400	444.4	
B-11	300	70.0	
B-14	250	1,289.0	
B-15	200	196.0	
B-16	200	256.4	
B-17	200	271.2	
B-18	300	27.3	
B-19	200	626.8	
B-20	400	9.6	
B-21	200	424.9	Force main
B-22	400	132.0	
C-1	200	628.1	
C-2	200	210.0	
C-3	250	280.0	
C-4	200	210.0	
C-5	400	350.0	
C-6	200	565.0	
C-7	200	350.0	
C-8	300	345.1	
C-9	200	140.0	
C-10	300	142.4	
C-11	500	203.9	
C-12	300	661.5	Force main
C-13	500	282.9	
Sub-total		12,862.6	
Replacement			
A-7	500	628.6	
A-8	700	576.8	
B-9	250	180.0	
B-10	500	63.0	
B-12	300	614.8	Force main
B-13	500	514.4	
B-23	600	271.9	
B-24	600	377.3	
B-25	800	640.6	
C-14	600	443.2	
C-15	600	827.2	
C-16	600	167.2	

Trunk sewer	Size (Diameter)	Length	Remark
C-17	600	213.0	
C-18	1,000	90.1	
Sub-total		5,608.1	
Total		18,470.7	

3.2.3 Sewage Pumping Station

(1) Design Conditions and Locations of Pumping Stations

As shown in **Table 3.2.2**, of new pumping stations will be constructed or rehabilitated at four locations, of which PS Darou Salam Ndangane and PS Boustane, are constructed to relay sewage to the downstream. The other two pumping stations, namely, PS No.1 South and PS No.1 North will be rehabilitated or newly constructed in the sewage treatment plant. All pumping stations are equipped with submergible type pumps, which are installed in existing pumping stations. Diesel generators will be equipped to all the new pumping stations as emergency power source. In PS No.2 and PS No.3, pumping equipment is replaced to augment their capacity.

(2) Preliminary Design of Pumping Station

Preliminary designs of PS Boustane, PS Darou Salam Ndangane, are shown in **Fig. 3.2.2** and **Fig. 3.2.3**. PS No.1 South and PS No.1 North are shown along with the structural drawing of STP in "Drawings and Design Notes".

Table 3.2.2 Components of Pumping Stations

	Design Inflow [1] (m^3/min)	Pumps installed m^3/min	unit	Capacity (m^3/min)	Total head (m)	Remarks
New construction						
PS No.1 North	15.9	4.0	2	16.0	12	Land owner: public
	(15.9)	8.0	1			Land requirement: 100 m^2
		8.0	1	Stand-by pump		
PS Darou Salam Ndangane	1.6	0.9	2	1.8	12	Land owner: public
	(1.8)	0.9	1	Stand-by pump		Land requirement: 150 m^2
PS Boustane	2.8	1.9	2	3.8	10	Land owner: private
	(3.8)	1.9	1	Stand-by pump		Land requirement: 200 m^2
Rehabilitation						
PS No.1 South	4.0	3.0	2	6.0	13	Land owner: ONAS
	(12.0)	6.0	1	Stand-by pump		Land requirement: 100 m^2
Replacement of pumping equipment						
PS No.2	5.7	3.2	2	6.4	15	Land owner: ONAS
	(12.9)	6.5	1	Stand-by pump		Existing area: 700 m^2
PS No.3	2.9	2.1	2	4.2	13	Land owner: ONAS
	(4.2)	2.1	1	Stand-by pump		Existing area: 500 m^2

Note 1) Values in parenthesis are design inflow in 2030

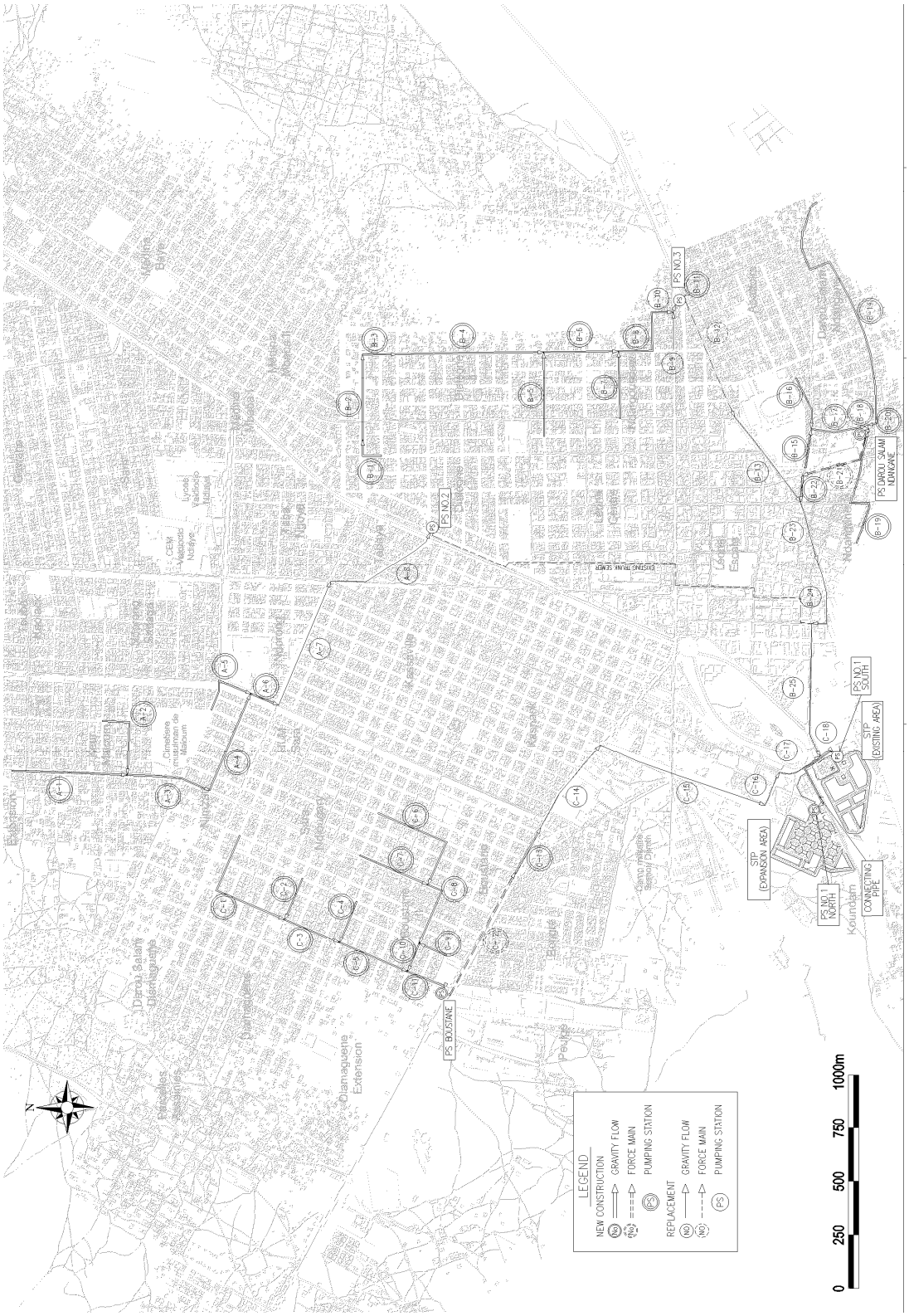


Fig. 3.2.1 Locations of Proposed Facilities

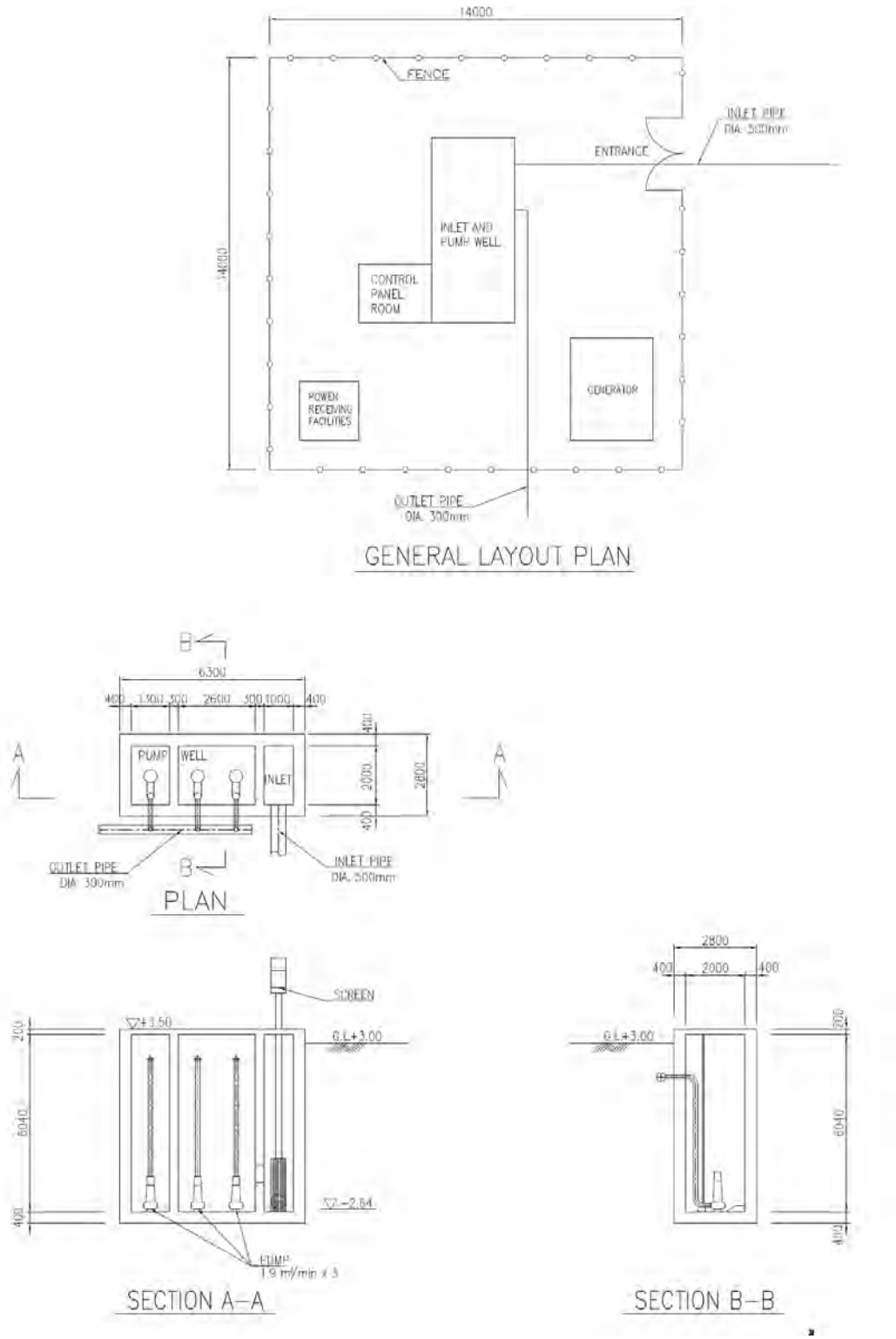


Fig. 3.2.2 Plan and Typical Cross Sections of PS Boustane

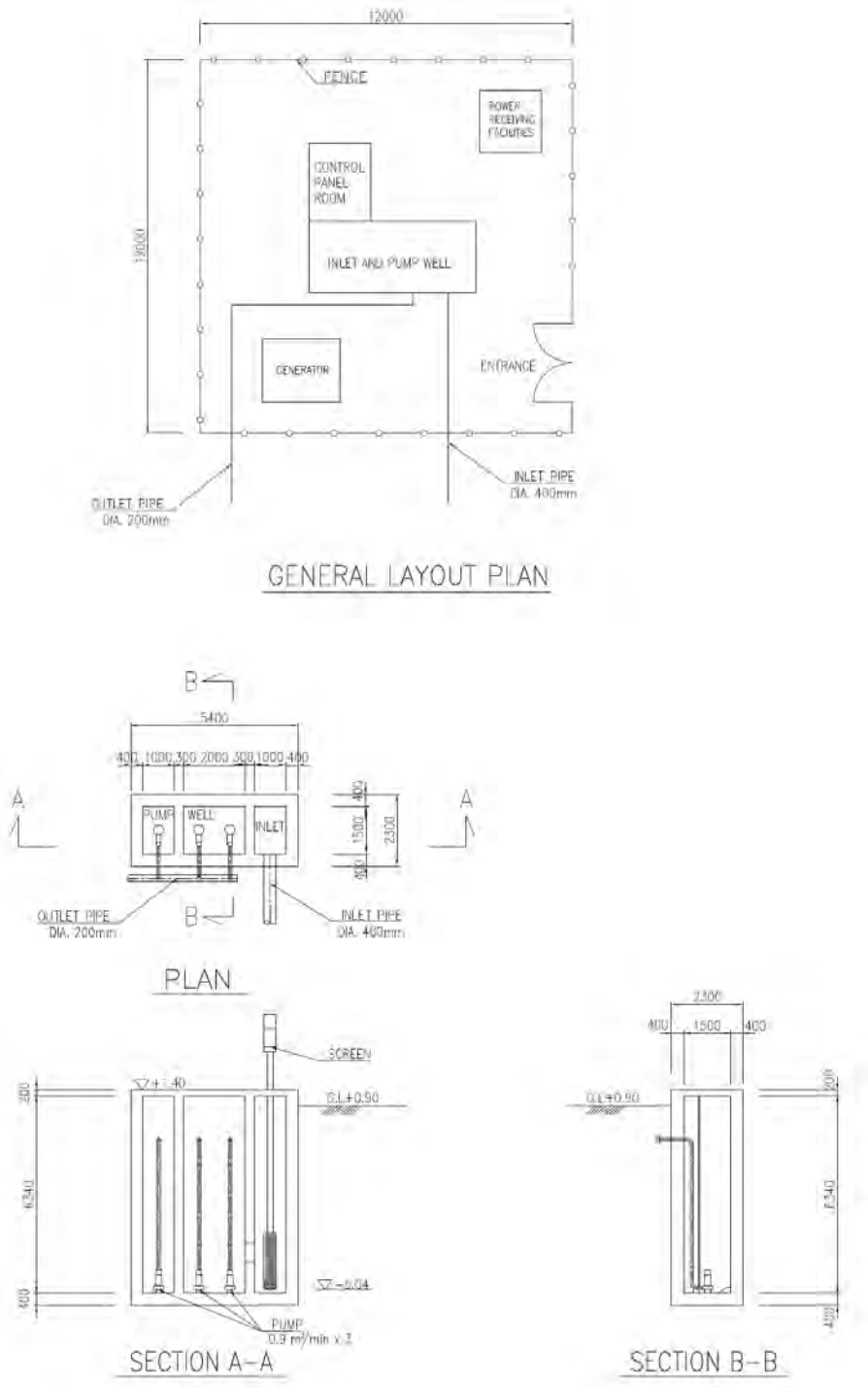


Fig. 3.2.3 Plan and Typical Cross Sections of PS Darou Salam Ndangane

3.2.4 Sewage Treatment Plant

As discussed in the Master Plan, to improve and expand the existing sewage treatment plant, (i) rehabilitation of existing lagoon in the existing area; (ii) aerated lagoons in the expansion area; and (iii) septage management facilities, are planned and/or designed as summarized in the following table. The connecting pipe is to be installed from the existing area (PS No.1 South) to the expansion area of STP

(PS No.1 North) to distribute the sewage inflow corresponding to the capacity of the aerated lagoon in the expansion area[1]

Table 3.2.3 Components of Sewage/Septage Treatment Plant

Name	Capacity/Quantity	Remarks
New construction		
Aerated lagoon	12,000 m^3/day	
Septage treatment facilities	70 m^3/day	BOD_5 load : 250 kg/day
Connecting pipe (diameter 800 mm)	382 m	Pipe number is C-19 in the drawings
Rehabilitation		
Lagoon	3,000 m^3/day	

(1) Alternative Study on the Location of Expansion Area

Before proceeding with the design of individual treatment facilities, the following two alternatives of the location of expansion area are set and a comparative study is conducted from such view points as cost, technical and environmental considerations.

The following figure presents the location of existing treatment plant and expansion area in the two alternatives. Alternative 1, which was proposed in Master Plan, has a layout in which the expansion area is located at the adjacent area of existing treatment plant as shown in **Fig. 3.2.4**. In the alternative, aerated lagoons including sedimentation lagoon are constructed in the expansion area. The layout is however modified from the one proposed in the Master Plan by laying out aerated lagoons on the inside of sedimentation lagoon area to prevent offensive odor from diffusing, as shown in **Fig 3.2.5**. Septage treatment facilities are constructed at adjacent of the existing area.

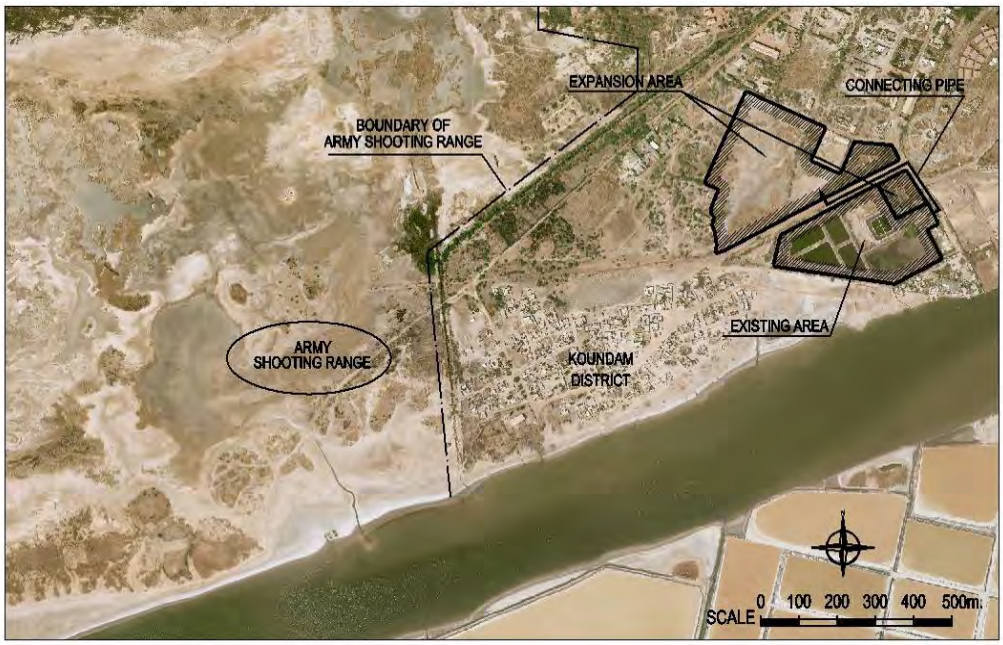


Fig. 3.2.4 Layout of Expansion Area in Alternative 1

[1] Pipe diameter of the connecting pipe is therefore smaller than that of the downstream-end trunk sewer (C-18) of 1,000 mm.

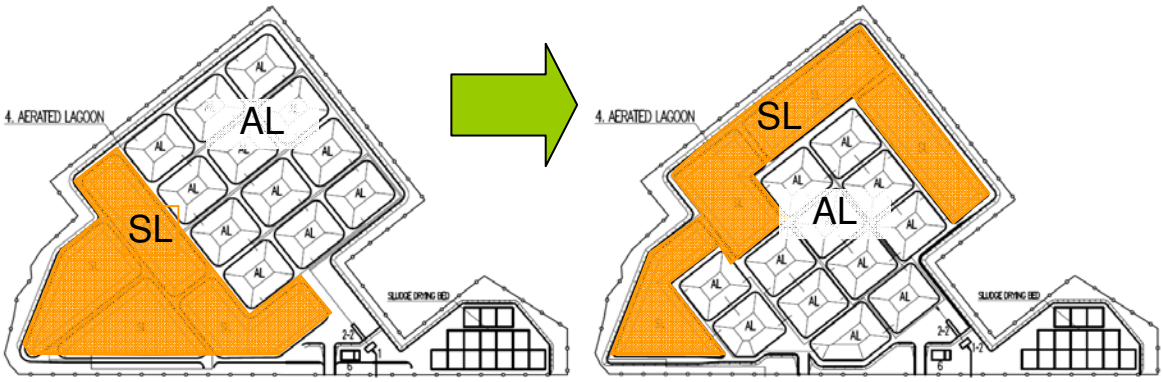


Fig. 3.2.5 Modification of Layout of Aerated Lagoon and Sedimentation Lagoon in the Expansion Area

Alternative 2 has an expansion area of more than 500 m distance from the nearest houses, buildings and so forth in accordance with the regulation in the environmental law of Senegal, as shown in **Fig. 3.2.6**. The expansion area in this Alternative is proposed in the army shooting area because no other area which can meet the above regulation is found in the neighboring area of the existing STP. In the alternative, aerated lagoon as well as septage treatment facilities are constructed in the expansion area.

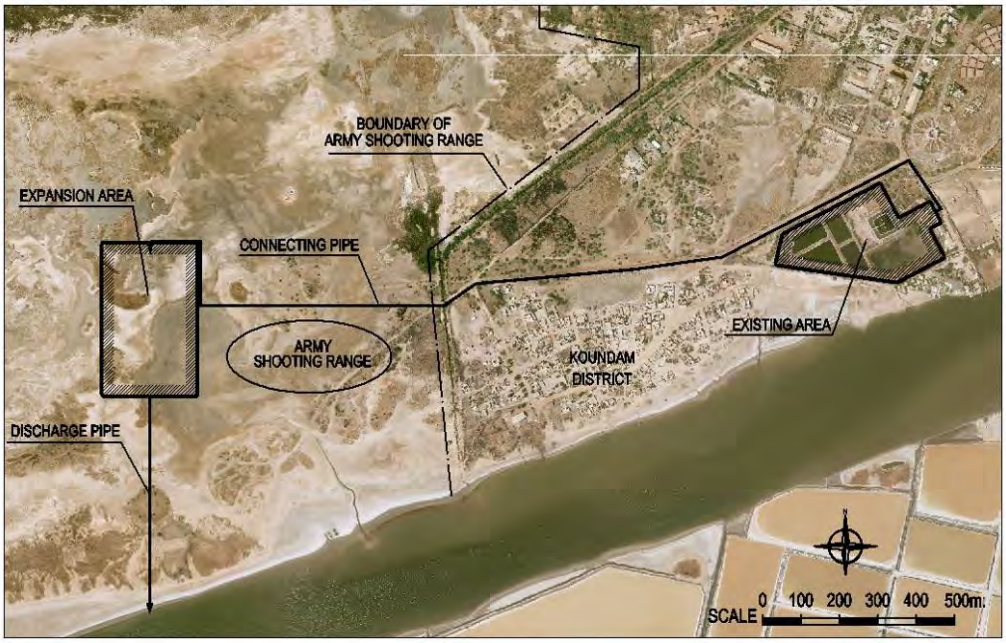
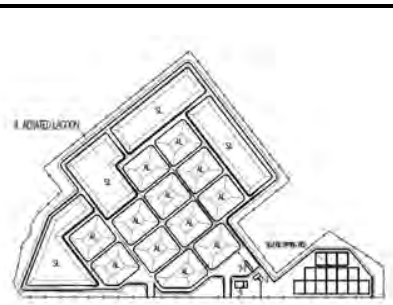
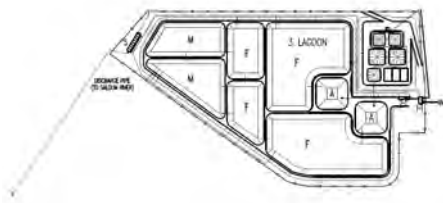


Fig. 3.2.6 Layout of Expansion Area in Alternative 2

Based on the two alternatives, detailed layout plans of existing and expansion area are prepared in **Table 3.2.4** with information on the facilities to be laid out in each area as well as the length of connecting pipe (a pipe connecting existing and expansion area).

Table 3.2.4 Detailed Layout Plan of the Alternatives

	Alternative 1	Alternative 2
Expansion area (layout)		
Facilities	Aerated lagoon (Capacity: 12,000 m^3/day)	Aerated lagoon (Capacity: 12,000 m^3/day)
	-	Septage treatment facilities
Existing area (layout)		
Facilities	Lagoon (Capacity: 3,000 m^3/day)	Lagoon (Capacity: 3,000 m^3/day)
	Septage treatment facilities	-
Connecting pipe	382 m (Diameter 800 mm)	2,500 m (Diameter 800 mm)

Based on the detailed layout plan, the two alternatives are compared under the following items of i) construction cost; ii) O&M cost; iii) environmental impact; iv) ease of O&M; and v) time period for completion of the project. In each item, a score of "+2" is given to the best Alternative while a score of "+1" is given to the second Alternative for ranking, as shown in **Table 3.2.5.**

As shown in the Table, construction cost of Alternative 2 is higher than that of Alternative 1, which is resulting mainly from difference of length of connecting pipe and volume of embankment in the expansion area. In addition, O&M cost of Alternative 2 is higher than that of Alternative 1 because the two locations of sewage treatment plant require more O&M staff.

Alternative 2 is better than Alternative 1 in terms of environmental impact as a whole. In Alternative 1; however, diffusion of odor, which is the major potential environmental impact, can be reduced by the proposed layout plan with mitigation measure of planting such trees as Eucalyptus on the boundary of treatment plant. In addition, wind direction data of Kaolack shows that diffusion of odor to the neighboring area, especially to Koundam District, is very limited. Besides, the EIA in the Feasibility Study reveals that (i) the regulation of 500 m distance in the environmental law of Senegal is not applicable to industrial area, and (ii) the expansion area of Alternative 1 is located in an industrial area. The above regulation is therefore not applicable to the expansion area of Alternative 1.

Alternative 1 is also more favorable than Alternative 2 in consideration of: i) single location of STP eases O&M works in STP; and ii) longer time period is expected to secure land in army shooting area.

Above discussion and evaluation in the following table shows that Alternative 1 is better than Alternative 2. As a result, individual sewage and septage treatment facilities are designed based on Alternative 1 in subsequent sub-sections.

Table 3.2.5 Results of Alternative Study on the Location of Expansion Area

Items	Alternative 1	Alternative 2
Construction cost (million FCFA)	9,120 +2	10,876 +1
O&M cost per year (million FCFA)	500 +2	547 +1
Environmental impact	Environmental impact is larger than that of Alternative 2 to some extent. But major potential impact, that is, diffusion of odor could be minimized by the proposed layout of aerated and sedimentation lagoons, as well as planting of such trees as Eucalyptus on the boundary of STP site. In addition, impact to people in the neighboring area (Koundam District) is very limited since wind direction data of Kaolack shows that north, south and west wind direction dominates in Kaolack. EIA in the Feasibility Study reveals that (i) the regulation of 500 m distance in the environmental law of Senegal is not applicable to industrial area, and (ii) the expansion area of this alternative is located in an industrial area. +1	Environmental impact to the neighboring area of expansion area is smaller than that of Alternative 1. +2
Ease of O&M	Expansion area is located at the adjacent area of existing area (existing STP), so operation and maintenance work is easier than that of Alternative 2. +2	Distance of about 2.5 km between existing and expansion area requires more operation and maintenance works. +1
Time period for completion of the project	Time is shorter than Alternative 2 because time period for securing the land in army shooting area is not required. +2	It will take long time to reach agreement with the agencies concerned in order to secure land in the army shooting area. +1
Evaluation	Best option Total: +9	Second option Total: +6

(2) Septage Treatment Facilities

Septage treatment facilities are constructed on the adjacent area of existing lagoon. Treated water in the septage treatment plant is introduced and treated in the subsequent rehabilitated lagoon. Configuration of the septage treatment facilities consists of receiving station from each vacuum car in which channel and screen are installed, sedimentation basin, anaerobic pond and flow balancing pond, as shown in **Fig. 3.2.7**. Sludge accumulated in the sedimentation basin is pumped up and conveyed to sludge drying beds.

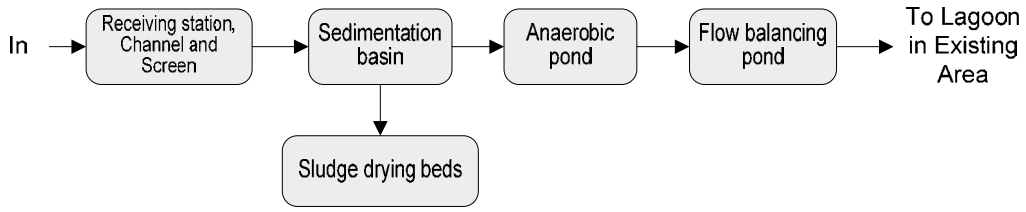


Fig. 3.2.7 Configuration of Septage Treatment Facilities

The septage treatment facilities are designed to accommodate 250 kg/day of BOD_5 load, which is equivalent of planning population of 230,000[2]. The population is determined based on the maximum population in the planning horizon up to 2030. Design parameters and specifications are delineated in **Table 3.2.6**. Layout plan and section of the facilities are shown in **Fig. 3.2.8**.

[2] Considering the present septic tank installation rate of 50 to 60 % in on-site sanitation area, the septage treatment facilities will not be overloaded in the years from 2020 to 2025.

Table 3.2.6 Design Parameters and Specifications of Septage Treatment Facilities

Items	Unit	Specifications	Remark
Characteristics of inflow			
Amount of septage	m^3/day	70	
BOD_5 load	kg/day	250	
BOD_5 concentration	mg/l	3,540	
Design specifications			
Receiving station Channel and screen		[Receiving station] 2.6 m (W) × 2.0 m (L) × 0.8 m (D) × 1 (Nos.) [Converging section (at downstream end)] 0.5 m (W) × 1.5 m (L) × 2 (Nos.) [Channel and screen] 0.5 m (W) × 1.7 m (L) × 2 (Nos.)	Free board 0.5 m Screen space 25.0 mm
Sedimentation basin		8.0 m (W) × 8.0 m (L) × 2.0 m (D) × 2 (Nos.)	Free board 0.5 m
Anaerobic pond		10.0 m (W) × 11.0 m (L) × 3.0 m (D) × 2 (Nos.)	Free board 0.5 m
Flow balancing pond		7.5 m (W) × 7.5 m (L) × 2.0 m (D) × 1 (Nos.)	Free board 0.8 m
Sludge drying beds		194 m^2 × 3 (Nos.)	

Note: W: Width, L: Length, D: Depth

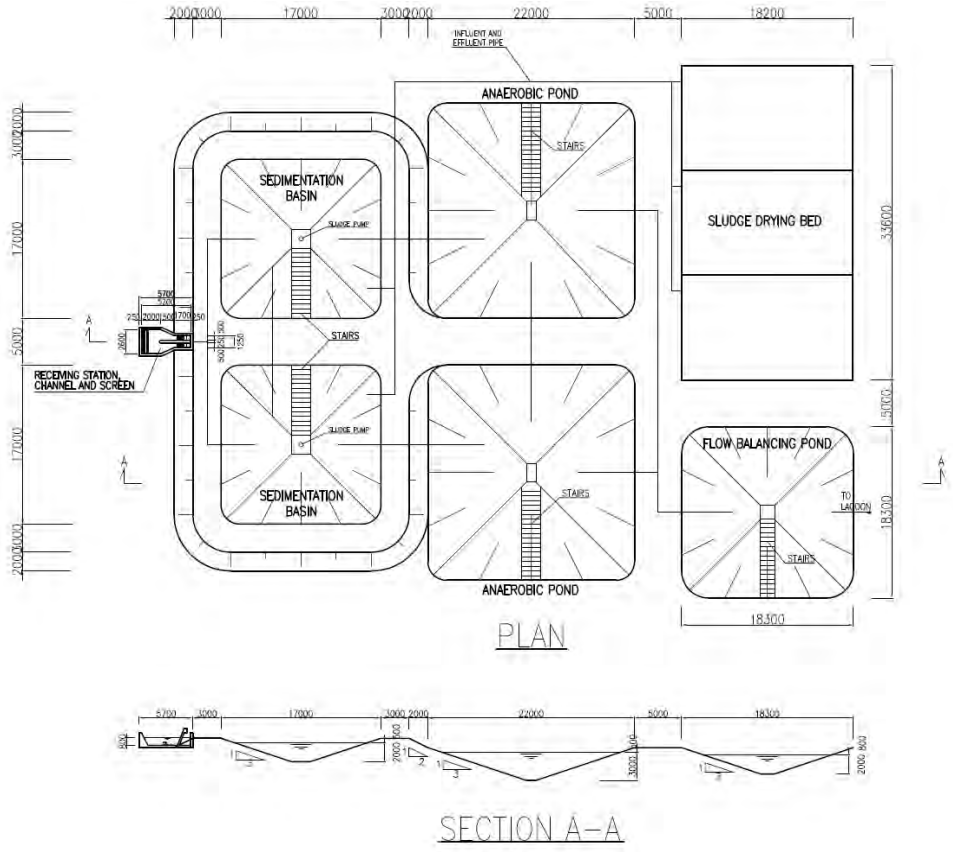


Fig. 3.2.8 Layout Plan and Section of Septage Treatment Facilities

(3) Rehabilitation of Existing Lagoon

Rehabilitation of existing lagoon is implemented focusing on existing facultative lagoon and aerated lagoon which is not being handed over.

(a) Design Conditions

Design conditions are set up in **Table 3.2.7**. Inflow and water quality is calculated based on compound of sewage and preliminary treated water in the septage treatment facilities. Lagoons are designed to meet discharge criteria of BOD_5=40 mg/l, TSS=50 mg/l, COD_{Cr}=100 mg/l and Fecal Coliform=2,000 CFU/100 ml.

Table 3.2.7 Design Parameters of Rehabilitation of Existing Lagoon

Items	Unit	Calculation		Remark
Inflow				
Sewerage	m^3/day	3,000		
Septage facilities	m^3/day	70		
Total	m^3/day	3,070		
Water quality				
		Influent	Effluent (Criteria)	
BOD_5	mg/l	489[1)]	40	
TSS	mg/l	611	50	611=489 × 1.25[2)]
COD_{Cr}	mg/l	978	100	978=489 × 2.00[2)]
Fecal coliform	CFU/100 ml	1.0×10^7	2.0×10^3	3)

Note: 1) BOD_5 of 489 mg/l is that of mixing liquor consisting of (i) sewerage: 3,000 m^3/day (BOD_5=485 mg/l) and (ii) septage: 70 m^3/day (BOD_5=640mg/l).
2) Influent BOD_5:TSS:COD_{Cr}=1.00:1.25:2.00 as discussed in the Master Plan
3) Influent fecal coliform is set considering water quality monitoring data in 2011

(b) Configuration

Existing facultative lagoon (including aerated lagoon which in not functioning) is rehabilitated by introducing the following configuration in **Fig. 3.2.9**. Thus, the existing facultative lagoon as well as aerated lagoon which are not functioning is replaced by an anaerobic lagoon and a facultative lagoon.

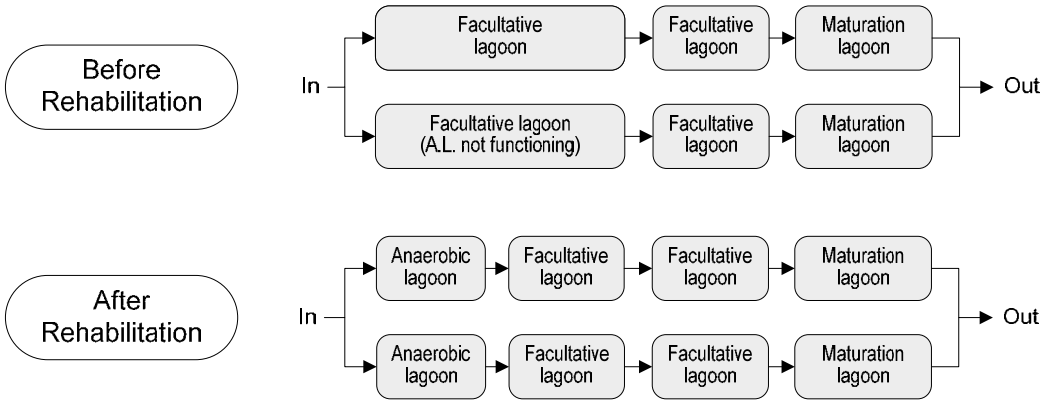


Fig. 3.2.9 Configuration Change of Existing Lagoon System in Existing Area

(c) Specification

Specifications of lagoons (Rehabilitated lagoons and existing lagoons) are summarized in **Table 3.2.8**.

Table 3.2.8 Specification of Rehabilitation of Existing Lagoon

Facilities	Specifications	HRT (days)
Rehabilitated		
Anaerobic lagoon	Area 900 m^2 × 3.0 m (D) × 2 (Nos.)	1.8
Existing		
Facultative lagoon		16.6
	Area 9,685 m^2 × 2.0 m (D) × 2 (Nos.)	
	Area 2,795 m^2 × 2.0 m (D) × 2 (Nos.)	
Maturation lagoon		4.0
	Area 3,810 m^2 × 1.5 m (D) × 2 (Nos.)	

Note: W: Width, L: Length, D: Depth

(4) Aerated Lagoons in Expansion Area

Aerated lagoons are constructed in the expansion area with the following conditions.

(a) Design Conditions

Aerated lagoon in the North Area is designed to have a capacity of 12,000 m^3/day and to meet discharge criteria of BOD_5=40 mg/l, TSS=50 mg/l, COD_{Cr}=100 mg/l and Fecal Coliform=2,000 CFU/100 ml, as shown in **Table 3.2.9**.

Table 3.2.9 Design Conditions of Aerated Lagoon

Items	Unit	Calculation		Remark
Inflow				
Sewerage	m^3/day	12,000		
Water quality				
		Influent	Effluent (Criteria)	
BOD_5	mg/l	485	40	
TSS	mg/l	606	50	606=485 × 1.25[1)]
COD_{Cr}	mg/l	970	100	970=485 × 2.00[1)]
Fecal coliform	CFU/100 ml	1.0×10^7	2.0×10^3	(1)

Note: 1) Influent BOD_5:TSS:COD_{Cr}=1.00:1.25:2.00 as discussed in the Master Plan
2) Influent fecal coliform is set up considering water quality monitoring data in 2011.

(b) Configuration

Aerated lagoons are designed with the following configuration (**Fig. 3.2.10**) consisting of aerated lagoons, sedimentation lagoons and chlorination chamber. In principle, pollution load in sewage is removed in the aerated lagoon. Sedimentation lagoon is set up to separate purified water and activated sludge. Treated water is introduced in augmented chlorination chamber which is located in the existing area. After chlorination, the treated water is combined with treated water from lagoons in the existing area and then discharged to Saloum River through newly constructed discharge pipe.

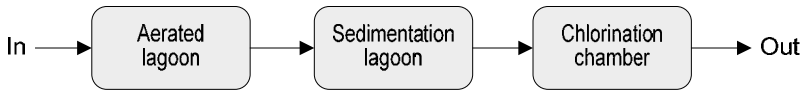


Fig. 3.2.10 Configuration of Aerated Lagoons in the Expansion Area

(c) Specification

Specifications of aerated lagoon, chlorination chamber and discharge pipe to Saloum River, are summarized in **Table 3.2.10**.

Table 3.2.10 Specification of Aerated Lagoon

Facilities	Specifications	HRT	Remarks
Aerated lagoon	Area 972 m^2 × 4.0 m (D) × 12 (Nos.)	3.7 days	Free board 1.0 m
Aerator	7.5 kw ×5 (Nos.) ×12 (lagoons)	-	
Sedimentation lagoon	Area 4,570 m^2 × 2.0 m (D) × 4 (Nos.) [1)]	1.5 days	Free board 0.5 m
Chlorination chamber	5.0 m (W) × 25.6 m (L) × 2.0 m (D)	30 min	
Sludge drying beds	Area 270 m^2 × 0.3 m (D)×15 (Nos.)	-	Free board 0.2 m
Discharge pipe	Diameter: 1, 000 mm × 250 m	-	

Note: Depth of 2.0 meter includes sludge allowance of 1.0 meter.
W: Width, L: Length, D: Depth

Typical layout plan and section of aerated lagoon is shown in **Fig. 3.2.11**.

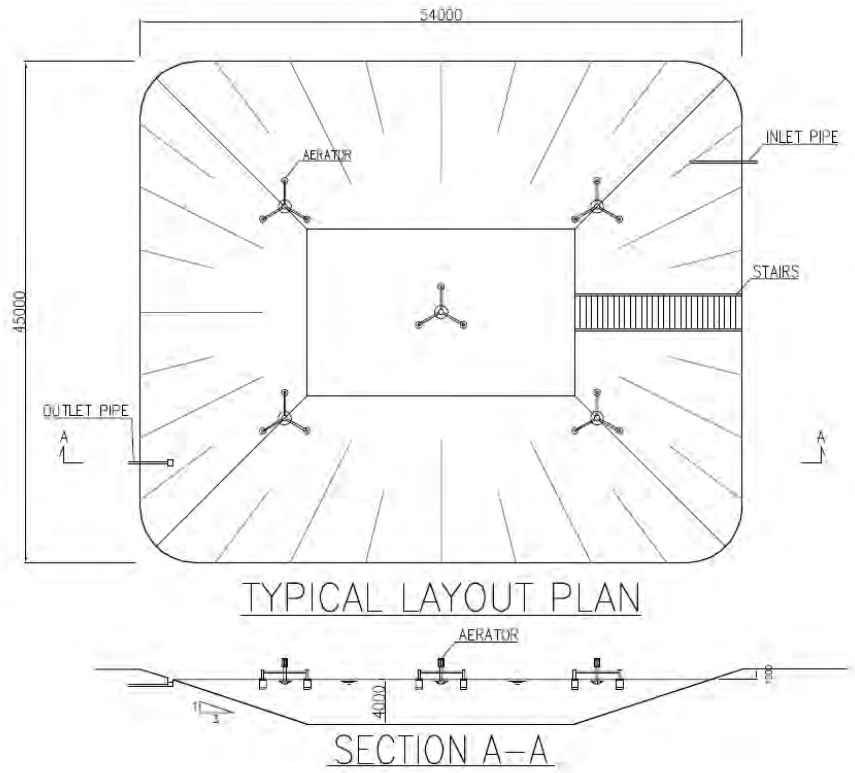


Fig. 3.2.11 Typical Layout Plan and Section of Aerated Lagoon

(5) Others

A diesel generator (300 kVA[3]) is newly equipped in the expansion area. On the other hand, existing diesel generator is used in the existing area.

Based on the above discussion, general layout plan of STP is shown in **Fig. 3.2.12**. Design calculation of lagoon and aerated lagoon detailed drawings of sewerage and sanitation facilities are as shown in the "Drawings and Design Notes".

[3] This specification is equivalent to the power of all pumps including stand-by pump. This specification is based on the reason that the HRT of aerated lagoon (about 4 days) is long enough to recover the decline in function during typical power outage time of several hours in Kaolack City.

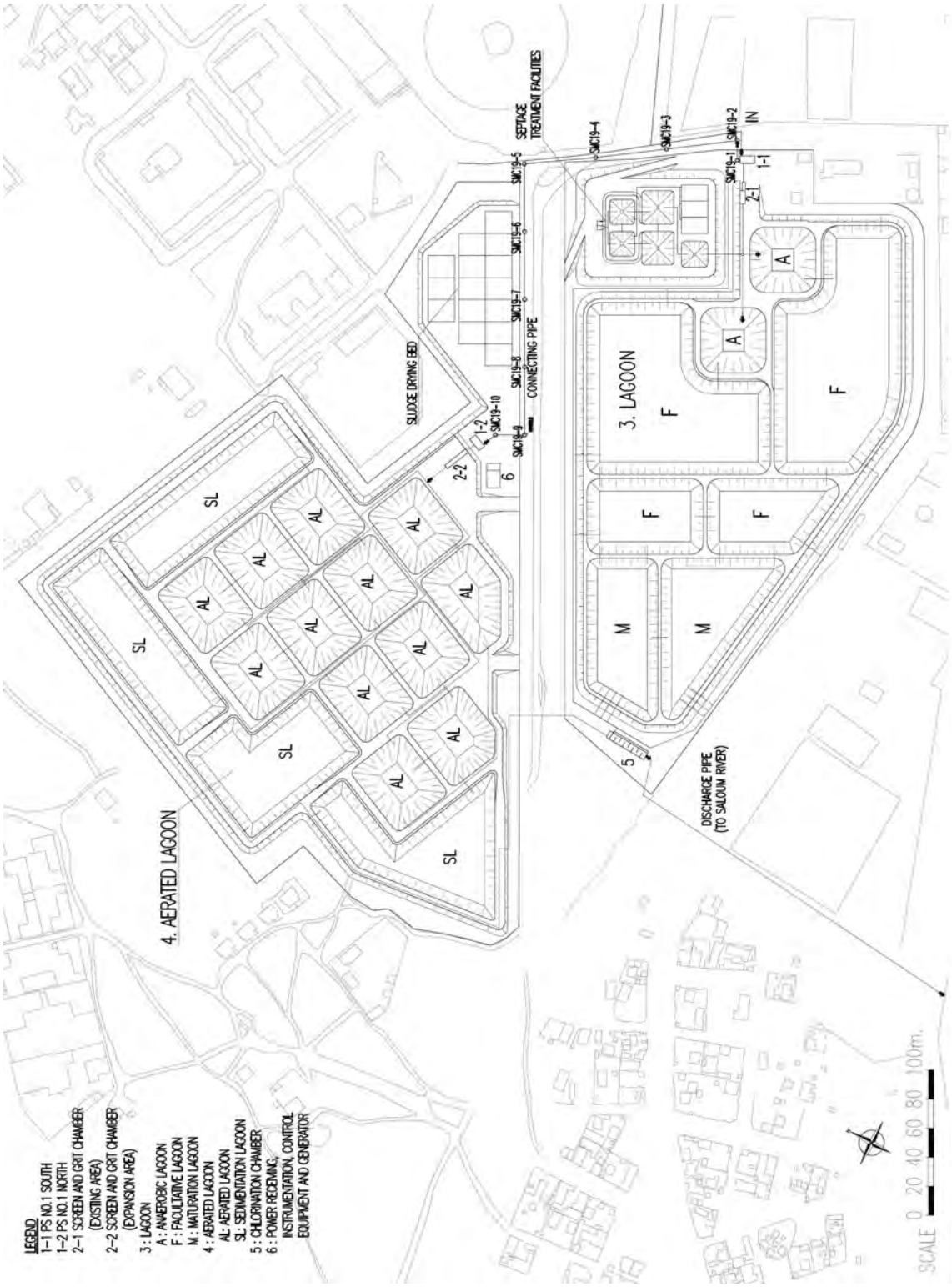


Fig. 3.2.12 General Layout of STP

3.3 Construction Plan

(1) General Circumstances

To consider the construction plan for sewerage and sanitation facilities, it is necessary to study the general circumstances relating to the availability of the construction materials. From the various information obtained from local and Japanese firms, the remarkable points on the procurement of construction materials are identified as follows:

- Available steel materials are very limited so that the temporary use of steel materials for the earth work and/or structural work is not a common method in Senegal.
- Available construction method is limited. For example, the Contractors in Senegal cannot carry out the pipe-jacking method for sewer network. If the pipe-jacking method is necessary, they have to look for foreign firm who can carry out that method.
- Mechanical items such as aerator, chlorinator, screen and submersible pump, etc. for STP and/or pumping station, need to be imported from foreign countries.
- There are no commercial batching plants for both ready mixed concrete and asphalt. Only major contractors in Dakar have their own batching plants.

(2) Construction Plan

Based on the above circumstances in Senegal, the followings are considered for the condition of construction for sewage and sanitation facilities, i.e. sewer network, sewage pumping stations, and sewage treatment plant.

- In general, open-cut excavation shall be applied.
- During the excavation below the underground water, it is necessary to lower the water table by using submersible water pumps.
- Standard cross section for excavation is as shown below. For the purpose of slope stability, 1 m width of temporary berm and 1:1 slope above the berm is assumed.

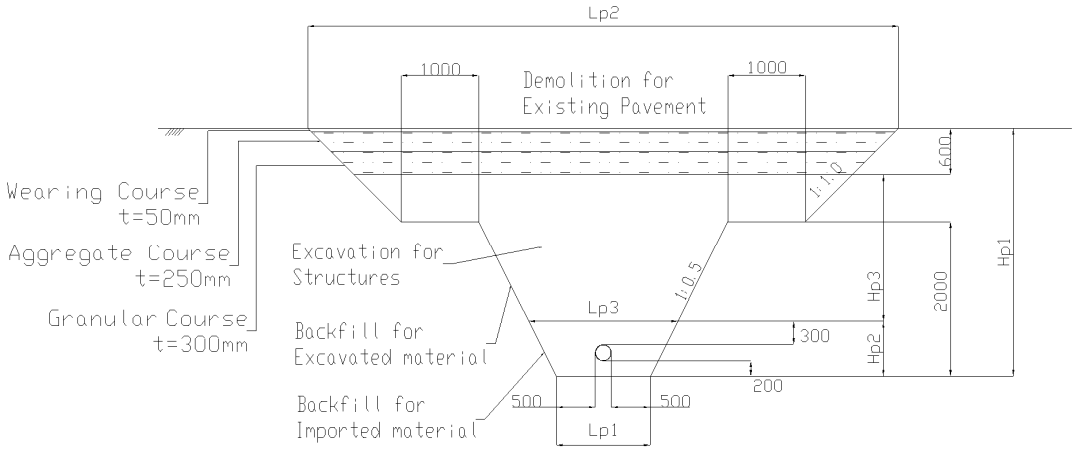


Fig. 3.3.1 Standard Cross Section of Excavation for Sewer Network

- On-site batching plant for both concrete and asphalt shall be set up.
- Where enough width for the road can not be kept due to open excavation, the existing road shall be used as temporary diversion road to keep the traffic.

- Use of temporary steel shoring is considered only for the construction of pumping well and the connection pipe (RC diameter of 800mm), that is 90 m long out of 380 m, due to space constraint.
- Use of imported sand shall be considered up to 300 mm above the sewer pipe. Remaining backfilling up to the finishing level of sub grade shall be carried out by using selected excavated soil. Especially the suitable material for the subgrade shall be selected carefully.
- Location of disposal yard for both excess excavated soil and concrete debris is about 15 km away from the center of Kaolack.
- Location of borrow pit for imported soil is about 20 km away from the center of Kaolack.

(3) Major Construction Machineries

Major construction machinery to be used for the Project is as follows:

Table 3.3.1 Major Construction Machinery

Works	Construction machineries
Earth Works	・ Excavators 0.7 to 1.2 m^3 ・ Dump Trucks 10 ton ・ Bulldozers 3 to16 ton ・ Compacting Rollers 1 ton ・ Tamping Rammer
Piling Works	・ Piling Rigs ・ Truck (or rough terrain) cranes 20 to 50 ton
Concrete Works	・ Truck (or rough terrain) cranes 20 to 25 ton ・ Concrete Pump Trucks ・ Concrete Hoppers (base machine 20 to 25 ton crane)1 m^3
Road Works	・ Giant Breakers ・ Bulldozers 12 to 16 ton ・ Wheel Loader 1 m^3 ・ Motor Graders ・ Macadam Rollers 10 ton ・ Tire Rollers 20 ton ・ Asphalt Pavers ・ Concrete Pavers
Mechanical Works	・ Truck (or rough terrain) cranes 20 to 25 ton ・ Crawler Cranes 100 ton

3.4 Cost Estimate

3.4.1 Construction and Engineering Costs

(1) Construction Cost

Construction Cost is calculated based on the various cost information obtained from ONAS Dakar, ONAS Kaolack, local firms and Japanese firms. The followings are the general conditions for the construction cost estimate.

- Construction cost is estimated at 2013 price level.
- Annual price escalation rate of 3% is applied when using cost data of past project.
- All necessary costs other than direct construction cost, i.e. the cost for common temporary works such as preparation of temporary site office, access road, and also the costs for site expenses, contractor's overhead, and profit, are included in construction cost.
- The cost is classified into foreign and local currency portions based on the information on the procurement obtained in Senegal.
- Construction methods are as stated in **Section 3.3** of construction plan.

(2) Engineering Cost

Engineering cost is the cost for consultancy services, i.e. the detailed design, pre-construction phase services including tender and construction supervision, etc. Engineering cost is calculated based on the cost information obtained from the local firms.

- Engineering cost is estimated at 2013 price level.
- The cost is classified into foreign and local currency portions assuming that both foreign consulting firm and local consulting firm involve jointly in the proposed project.
- The following durations are assumed for the consulting services.
  - Detailed Design, Pre-construction Phase Services 18 months
  - Construction Supervision 30 months
- Price Escalation (FC 2.0%, LC 3.0%) is included.
- Physical Contingency (10%) is included.

3.4.2 Project Cost

(1) Element of Project Cost

Element of project cost is as follows.

- Construction Cost [Refer to **Sub-section 3.4.1 (1)**]
- Price Escalation: Annual Rate FC 2% , LC 3% for construction cost
- Physical Contingency: 10 % of construction cost
- Engineering Cost (Refer to **Sub-section 3.4.1 (2)**)
- Land Acquisition Cost (acquisition cost of vacant land for new construction of facilities): 25,000 FCFA/m^2 for STP expansion area and 10,000 to 12,500 FCFA for two pumping stations (PS Boustane and PS Darou Salam Ndangane), inclusive of the price escalation and physical contingency that is the same percentage of construction cost and engineering cost
- Project Administration Cost: 2% of total amount for construction cost, engineering cost and land acquisition cost
- VAT: 18%
- Import Tax: 9%
- Interest Rate during Construction Project: Annual Rate 1.4 % for construction cost, 0.01 % for engineering cost
- Front-end Fee: 0.2 % of total amount for construction cost, engineering cost and interest during construction

Above-mentioned percentages for each element are set based on the following points of view:

- Price escalation during the project from 2015 and 2019 is assumed based on the past 10-year data on the inflation rate by the World Bank.
- Percentage of both physical contingency and project administration cost is assumed judging from the data obtained from the past project in Senegal or other countries.
- Planned materials to be imported are steel materials such as steel piles, ductile iron pipes, sheet piles, etc. and mechanical equipment. Import tax of 9% for those materials is assumed based on the information from local and Japanese firms.
- Land acquisition cost is based on the information from the Ministry of Economy and Finance.
- Interest rate during construction project is calculated based on the duration of project (2015 to 2019). The assumed percentage is based on the condition of the Yen loan. The percentage for interest rate during construction of the project is determined by GNI (Gross National Income) per capita. In case of Senegal, since GNI per capita is between USD1,026 and USD1,945, the percentage for low income country is applied.

(2) Project Cost Estimate

Project cost is estimated based on the above-mentioned elements. Total project cost amounts to approximately 31,713 million FCFA at 2013 price level, of which 25,162 million FCFA is local currency portion and 6,551 million FCFA is foreign currency portion. The construction costs of PS No.1 North and PS No.1 South are included in those of aerated lagoon and rehabilitation of lagoon, respectively because these pumping stations are considered to be a part of the treatment facilities. Construction cost of branch sewer installation is not included in **Table 3.4.1** and **Table 3.4.2** because the branch sewer installation is not included in the project components.

Table 3.4.1 Project Cost

Cost Items	Work Items	L/C (million FCFA)	F/C (million FCFA)	Total (million FCFA)
Construction Cost	Trunk Sewer Network	5,774	0	5,774
	Pumping Station[1)]	213	386	599
	Sewage Treatment Plant			
	Aerated Lagoon[2)]	3,964	3,413	7,377
	Septage Treatment Facilities	385	52	437
	Rehabilitation of Lagoon[3)]	1,217	89	1,306
	Sub Total (STP)	5,566	3,554	9,120
	Total	11,553	3,940	15,493
Price Escalation		1,824	395	2,219
Physical Contingency		1,338	434	1,772
Engineering Service		2,127	1,164	3,291
Land Acquisition		3,270	0	3,270
Government Administration		521	0	521
VAT		4,100	0	4,100
Import Tax		429	0	429
Interest during Construction		0	571	571
Front-end Fee		0	47	47
Total (million FCFA)		25,162	6,551	31,713

Note: 1) Including PS Boustane, PS Darou Salam Ndangane, PS No.2 and PS No.3. Cost of PS No.1 North and PS No.1 South is included in the cost of sewage treatment plant.
2) Including PS No.1 North
3) Including PS No.1 South

(3) Detailed Cost for Trunk Sewer Network

The breakdown of construction cost for sewer network is as shown in **Table 3.4.2.**

Table 3.4.2 Detailed Cost for Trunk Sewer Network

Trunk No.	(million FCFA)	Trunk No.	(million FCFA)	Trunk No.	(million FCFA)	Trunk No.	(million FCFA)
A-1	166	B-6	115	B-19	104	C-7	54
A-2	46	B-7	101	B-20	5	C-8	84
A-3	133	B-8	154	B-21	91	C-9	25
A-4	65	B-9	106	B-22	20	C-10	35
A-5	34	B-10	48	B-23	76	C-11	91
A-6	72	B-11	23	B-24	132	C-12	166
A-7	225	B-12	89	B-25	337	C-13	185
A-8	497	B-13	126	C-1	85	C-14	389
B-1	13	B-14	343	C-2	24	C-15	341
B-2	44	B-15	17	C-3	51	C-16	68
B-3	34	B-16	102	C-4	20	C-17	193
B-4	199	B-17	29	C-5	126	C-18	111
B-5	48	B-18	11	C-6	121		
					Total (million FCFA)		5,774

Note: Cost of Pipe No. C-19, which is a connecting pipe between the existing and expansion area of STP, is not included in the table. Instead, cost of the pipe is included in the cost of STP.

3.4.3 O&M Cost

Annual operation and maintenance cost of sewerage and sanitation improvement facilities are estimated as follows. The cost includes cleaning work cost, sludge disposal, electricity bill, and personal expense.

Table 3.4.3 Annual O&M Cost

	Items	Cost (FCFA/year)
Sewer pipe	Cleaning and maintenance including personal expense and materials	127
Pumping station	Cleaning and maintenance including personal expense and materials	84
	Electricity	78
	Sub-total	162
STP[1)]	Personal expense	8
	Electricity	408
	Material and repair	46
	Chemicals	33
	Sludge disposal	5
	Sub-total	500
Total		789

Note: 1) Cost including O&M cost of PS No.1 North and South
2) 131.1 FCFA/kWh is employed to estimate electricity expense based on the information from ONAS Kaolack

3.5 Economic and Financial Analysis

3.5.1 Economic Analysis on Priority Project

(1) Methodology

Preconditions of the analysis for the priority project are the same as those of the Master Plan (Refer to **Sub-section 4.8.1 Methodology** of the Master Plan part for the details of the methodology).

(2) Cost-Benefit Analysis

(a) Project Cost

The following items are included in the cost calculation:

- Construction Works
- Physical Contingency
- Consulting Services
- Land Acquisition
- Administration Cost
- Operation and Maintenance Cost

The land to be used for the facilities was finally identified as private land, and there is some possibility that it will be used for economic activities. Thus, the land acquisition cost is included with the analysis. These cost items are converted to economic costs. Calculation results are shown in **Tables 3.5.2** to **3.5.4**.

(b) Project Benefit

This project has positive effects on the improvement of living environment in the target area, whose benefit can be calculated by the people's willingness-to-pay.

Willingness-To-Pay (WTP)

According to the results of the Socio-economic Survey conducted by the JICA Expert Team, 20.0% of the interviewees answered that the WTP for the improvement of sanitary conditions was 500 FCFA per month or 6,000 FCFA per year in 2012 and 7.0% answered 1,000 FCFA per month or 12,000 FCFA per year. The weighted average is 202 FCFA per month or 2,429 FCFA per year. It is assumed that the WTP increases in accordance with the GDP per capita growth

rate. The targeted population includes those who connect to the sewerage system and the septic tank users. The total WTP in the target area is shown below.

Table 3.5.1 Total WTP for the Improvement of Living Environment in Target Area

	2012	2015	2020	2025	2030
Targeted Population (thousand)	144	169	259	339	403
WTP of 500 FCFA case (FCFA/pers/year)	6,000	6,196	6,522	6,849	7,175
Total WTP for 500 FCFA case (million FCFA/year)	–	0	1,610	1,867	2,096
WTP of 1,000 FCFA case (FCFA/pers/year)	12,000	12,392	13,044	13,697	14,350
Total WTP for 1,000 FCFA (million FCFA/year)	–	0	3,221	3,734	4,192
WTP of Weighted Average case (FCFA/pers/year)	2,429	2,508	2,640	2,772	2,904
Total WTP for Weighted Average case (million FCFA/year)	–	0	652	756	848

The benefit from the priority project is allocated in proportion to the ratio of its construction cost to that of the Master Plan. The benefit accrues in accordance with the progress of the construction before 2020. Thus, Full of Total WTP in **Table 3.5.1** accrues after the completion of construction in 2019.

(c) Calculation Results

EIRR is calculated at 5.2% for WTP of 500 FCFA and 13.3% for WTP of 1,000 FCFA and -4.2% for WTP of 202 FCFA (weighted average) since its benefit is too low. WTP of 1,000 FCFA is around the same level as the solid waste collection fee which is presently paid by users and hence this amount can be realized by education and dissemination campaigns to the people. Detailed calculations are shown in **Tables 3.5.2** to **3.5.4**.

Table 3.5.2 EIRR Calculation (WTP of 500 FCFA)

Unit: Million FCFA

Year	Cost							Benefit	Net Benefit
	Construction Works	Physical Contingency	Consulting Services	Land Acquisition	Administration Cost	O&M	Total		
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	155.3	0.0	2.5	0.0	157.8	0.0	-157.8
2016	0.0	0.0	1,356.2	1,628.8	58.0	0.0	3,043.0	0.0	-3,043.0
2017	4,211.4	468.6	471.3	1,118.0	129.4	0.0	6,398.8	0.0	-6,398.8
2018	6,416.2	732.5	601.9	0.0	164.6	204.6	8,119.8	439.9	-7,679.9
2019	3,016.9	356.8	366.0	0.0	83.2	516.2	4,339.1	1,212.3	-3,126.8
2020	0.0	0.0	0.0	0.0	0.0	662.8	662.8	1,610.4	947.6
2021						662.8	662.8	1,660.0	997.2
2022						662.8	662.8	1,710.5	1,047.7
2023						662.8	662.8	1,761.7	1,099.0
2024						662.8	662.8	1,813.9	1,151.1
2025						662.8	662.8	1,866.9	1,204.1
2026						662.8	662.8	1,911.4	1,248.6
2027						662.8	662.8	1,956.6	1,293.8
2028						662.8	662.8	2,002.4	1,339.6
2029						662.8	662.8	2,048.9	1,386.2
2030						662.8	662.8	2,096.1	1,433.3
2031						662.8	662.8	2,096.1	1,433.3
2032						662.8	662.8	2,096.1	1,433.3
2033						662.8	662.8	2,096.1	1,433.3
2034						662.8	662.8	2,096.1	1,433.3
2035						662.8	662.8	2,096.1	1,433.3
2036						662.8	662.8	2,096.1	1,433.3
2037						662.8	662.8	2,096.1	1,433.3
2038						662.8	662.8	2,096.1	1,433.3
2039						662.8	662.8	2,096.1	1,433.3
2040						662.8	662.8	2,096.1	1,433.3
2041						662.8	662.8	2,096.1	1,433.3
2042						662.8	662.8	2,096.1	1,433.3
2043						662.8	662.8	2,096.1	1,433.3
2044						662.8	662.8	2,096.1	1,433.3
2045						662.8	662.8	2,096.1	1,433.3
2046						662.8	662.8	2,096.1	1,433.3
2047						662.8	662.8	2,096.1	1,433.3
2048						662.8	662.8	2,096.1	1,433.3
2049						662.8	662.8	2,096.1	1,433.3
2050						662.8	662.8	2,096.1	1,433.3
2051						662.8	662.8	2,096.1	1,433.3
2052						662.8	662.8	2,096.1	1,433.3
2053						662.8	662.8	2,096.1	1,433.3
2054						662.8	662.8	2,096.1	1,433.3
2055						662.8	662.8	2,096.1	1,433.3
2056						662.8	662.8	2,096.1	1,433.3
2057						662.8	662.8	2,096.1	1,433.3
2058						662.8	662.8	2,096.1	1,433.3
2059						662.8	662.8	2,096.1	1,433.3
2060						662.8	662.8	2,096.1	1,433.3
Total	13,644.5	1,557.9	2,950.7	2,746.8	437.6				
								EIRR	5.2%

Table 3.5.3 EIRR Calculation (WTP of 1,000 FCFA)

Unit: Million FCFA

Year	Cost							Benefit	Net Benefit
	Construction Works	Physical Contingency	Consulting Services	Land Acquisition	Administration Cost	O&M	Total		
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	155.3	0.0	2.5	0.0	157.8	0.0	-157.8
2016	0.0	0.0	1,356.2	1,628.8	58.0	0.0	3,043.0	0.0	-3,043.0
2017	4,211.4	468.6	471.3	1,118.0	129.4	0.0	6,398.8	0.0	-6,398.8
2018	6,416.2	732.5	601.9	0.0	164.6	204.6	8,119.8	879.8	-7,240.0
2019	3,016.9	356.8	366.0	0.0	83.2	516.2	4,339.1	2,424.6	-1,914.5
2020	0.0	0.0	0.0	0.0	0.0	662.8	662.8	3,220.8	2,558.0
2021						662.8	662.8	3,320.0	2,657.2
2022						662.8	662.8	3,420.9	2,758.1
2023						662.8	662.8	3,523.5	2,860.7
2024						662.8	662.8	3,627.8	2,965.0
2025						662.8	662.8	3,733.8	3,071.0
2026						662.8	662.8	3,822.8	3,160.0
2027						662.8	662.8	3,913.1	3,250.4
2028						662.8	662.8	4,004.8	3,342.0
2029						662.8	662.8	4,097.8	3,435.1
2030						662.8	662.8	4,192.2	3,529.4
2031						662.8	662.8	4,192.2	3,529.4
2032						662.8	662.8	4,192.2	3,529.4
2033						662.8	662.8	4,192.2	3,529.4
2034						662.8	662.8	4,192.2	3,529.4
2035						662.8	662.8	4,192.2	3,529.4
2036						662.8	662.8	4,192.2	3,529.4
2037						662.8	662.8	4,192.2	3,529.4
2038						662.8	662.8	4,192.2	3,529.4
2039						662.8	662.8	4,192.2	3,529.4
2040						662.8	662.8	4,192.2	3,529.4
2041						662.8	662.8	4,192.2	3,529.4
2042						662.8	662.8	4,192.2	3,529.4
2043						662.8	662.8	4,192.2	3,529.4
2044						662.8	662.8	4,192.2	3,529.4
2045						662.8	662.8	4,192.2	3,529.4
2046						662.8	662.8	4,192.2	3,529.4
2047						662.8	662.8	4,192.2	3,529.4
2048						662.8	662.8	4,192.2	3,529.4
2049						662.8	662.8	4,192.2	3,529.4
2050						662.8	662.8	4,192.2	3,529.4
2051						662.8	662.8	4,192.2	3,529.4
2052						662.8	662.8	4,192.2	3,529.4
2053						662.8	662.8	4,192.2	3,529.4
2054						662.8	662.8	4,192.2	3,529.4
2055						662.8	662.8	4,192.2	3,529.4
2056						662.8	662.8	4,192.2	3,529.4
2057						662.8	662.8	4,192.2	3,529.4
2058						662.8	662.8	4,192.2	3,529.4
2059						662.8	662.8	4,192.2	3,529.4
2060						662.8	662.8	4,192.2	3,529.4
Total	13,644.5	1,557.9	2,950.7	2,746.8	437.6				
								EIRR	13.3%

Table 3.5.4 EIRR Calculation (WTP of Weighted Average)

Unit: Million FCFA

Year	Cost							Benefit	Net Benefit
	Construction Works	Physical Contingency	Consulting Services	Land Acquisition	Administration Cost	O&M	Total		
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	155.3	0.0	2.5	0.0	157.8	0.0	-157.8
2016	0.0	0.0	1,356.2	1,628.8	58.0	0.0	3,043.0	0.0	-3,043.0
2017	4,211.4	468.6	471.3	1,118.0	129.4	0.0	6,398.8	0.0	-6,398.8
2018	6,416.2	732.5	601.9	0.0	164.6	204.6	8,119.8	178.1	-7,941.7
2019	3,016.9	356.8	366.0	0.0	83.2	516.2	4,339.1	490.7	-3,848.4
2020	0.0	0.0	0.0	0.0	0.0	662.8	662.8	651.8	-10.9
2021						662.8	662.8	671.9	9.1
2022						662.8	662.8	692.3	29.6
2023						662.8	662.8	713.1	50.3
2024						662.8	662.8	734.2	71.4
2025						662.8	662.8	755.6	92.9
2026						662.8	662.8	773.7	110.9
2027						662.8	662.8	791.9	129.2
2028						662.8	662.8	810.5	147.7
2029						662.8	662.8	829.3	166.6
2030						662.8	662.8	848.4	185.7
2031						662.8	662.8	848.4	185.7
2032						662.8	662.8	848.4	185.7
2033						662.8	662.8	848.4	185.7
2034						662.8	662.8	848.4	185.7
2035						662.8	662.8	848.4	185.7
2036						662.8	662.8	848.4	185.7
2037						662.8	662.8	848.4	185.7
2038						662.8	662.8	848.4	185.7
2039						662.8	662.8	848.4	185.7
2040						662.8	662.8	848.4	185.7
2041						662.8	662.8	848.4	185.7
2042						662.8	662.8	848.4	185.7
2043						662.8	662.8	848.4	185.7
2044						662.8	662.8	848.4	185.7
2045						662.8	662.8	848.4	185.7
2046						662.8	662.8	848.4	185.7
2047						662.8	662.8	848.4	185.7
2048						662.8	662.8	848.4	185.7
2049						662.8	662.8	848.4	185.7
2050						662.8	662.8	848.4	185.7
2051						662.8	662.8	848.4	185.7
2052						662.8	662.8	848.4	185.7
2053						662.8	662.8	848.4	185.7
2054						662.8	662.8	848.4	185.7
2055						662.8	662.8	848.4	185.7
2056						662.8	662.8	848.4	185.7
2057						662.8	662.8	848.4	185.7
2058						662.8	662.8	848.4	185.7
2059						662.8	662.8	848.4	185.7
2060						662.8	662.8	848.4	185.7
Total	13,644.5	1,557.9	2,950.7	2,746.8	437.6				
								EIRR	-4.2%

3.5.2 Financial Analysis on Priority Project

(1) Methodology

Preconditions of the analysis for the priority project are the same as those of the Master Plan (Refer to **Sub-section 4.9.1 Methodology** of the Master Plan part for the details of the methodology).

(2) Cost-Benefit Analysis

(a) Project Cost

The following items are included in the cost calculation:

- Construction Works
- Physical Contingency
- Consulting Services
- Land Acquisition
- Administration Cost
- VAT
- Import Tax
- Operation and Maintenance Cost

The land to be used for the facilities was finally identified as private land, and there is some possibility that it will be used for economic activities. Thus, land acquisition cost is included. Calculation results are shown in **Tables 3.5.6** to **3.5.8**.

(b) Project Benefit

Project benefits are the revenues from: i) sewerage charges, that is, 8% of water supply charge which is collected together with the water supply charge for the people in sewerage area, and ii) septage treatment charge outside the sewerage area. However, since sewerage charge is presently collected also from those who have no connection to the sewerage system, sewerage charge is applied to all the people for the purpose of benefit calculation.

Presently, sewerage charge for each concession is 10 FCFA per CM (cubic meter) of water consumption up to 20 CM and 45.65 FCFA per CM of water consumption from 21 CM to 40 CM. Average charge per CM is calculated with average number of people in one concession, 9.45 in 2012 by Kaolack City. It is regarded as the base case to estimate how many times the charge should be increased in the calculation of FIRR.

Table 3.5.5 Total Revenue from Sewerage Charge

	2012	2015	2020	2025	2030
Target Population (thousand)	–	169	259	339	403
Water Consumption (lpcd)	74.0	76.0	80.0	84.0	88.0
Average Charge (FCFA/CM)	11.98	12.87	14.51	15.99	17.34
Total Water Consumption (thousand CM/yr)	–	4,682	7,566	10,406	12,944
Total Revenue (million FCFA)	–	0	103	126	148

The benefit of the priority project is allocated in proportion to the ratio of its construction cost to that of the Master Plan. The benefit accrues in accordance with the progress of the construction before 2020. Thus, Full of Total Revenue in **Table 3.5.5** accrues after the completion of construction in 2019.

(c) Calculation Results

FIRR cannot be calculated with the base case because the benefit is too low, which means that sewerage charge is set at a very low level. FIRR will be 0.0% if the sewerage charge is increased to 10.5 times and 12.0% (equal to Social Discount Rate) if 35.5 times. Detailed calculations are shown in **Tables 3.5.6** to **3.5.8**.

Table 3.5.6 FIRR Calculation (Base Case)

Unit: Million FCFA

Year	Cost									Benefit	Net Benefit
	Construction Works	Physical Contingency	Consulting Services	Land Acquisition	Administration	VAT	Import Tax	O&M	Total		
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	170.0	0.0	3.0	31.0	0.0	0.0	204.0	0.0	-204.0
2016	0.0	0.0	1,494.0	1,939.0	69.0	269.0	0.0	0.0	3,771.0	0.0	-3,771.0
2017	4,766.0	531.0	527.0	1,331.0	154.0	1,146.0	139.0	0.0	8,594.0	0.0	-8,594.0
2018	7,248.0	829.0	687.0	0.0	196.0	1,765.0	224.0	242.7	11,191.7	27.2	-11,164.5
2019	3,479.0	412.0	413.0	0.0	99.0	889.0	66.0	611.8	5,969.8	76.7	-5,893.1
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	789.0	789.0	103.2	-685.8
2021								789.0	789.0	107.3	-681.7
2022								789.0	789.0	111.6	-677.4
2023								789.0	789.0	116.1	-672.9
2024								789.0	789.0	120.7	-668.3
2025								789.0	789.0	125.5	-663.5
2026								789.0	789.0	129.8	-659.2
2027								789.0	789.0	134.3	-654.7
2028								789.0	789.0	138.9	-650.1
2029								789.0	789.0	143.6	-645.4
2030								789.0	789.0	148.4	-640.6
2031								789.0	789.0	148.4	-640.6
2032								789.0	789.0	148.4	-640.6
2033								789.0	789.0	148.4	-640.6
2034								789.0	789.0	148.4	-640.6
2035								789.0	789.0	148.4	-640.6
2036								789.0	789.0	148.4	-640.6
2037								789.0	789.0	148.4	-640.6
2038								789.0	789.0	148.4	-640.6
2039								789.0	789.0	148.4	-640.6
2040								789.0	789.0	148.4	-640.6
2041								789.0	789.0	148.4	-640.6
2042								789.0	789.0	148.4	-640.6
2043								789.0	789.0	148.4	-640.6
2044								789.0	789.0	148.4	-640.6
2045								789.0	789.0	148.4	-640.6
2046								789.0	789.0	148.4	-640.6
2047								789.0	789.0	148.4	-640.6
2048								789.0	789.0	148.4	-640.6
2049								789.0	789.0	148.4	-640.6
2050								789.0	789.0	148.4	-640.6
2051								789.0	789.0	148.4	-640.6
2052								789.0	789.0	148.4	-640.6
2053								789.0	789.0	148.4	-640.6
2054								789.0	789.0	148.4	-640.6
2055								789.0	789.0	148.4	-640.6
2056								789.0	789.0	148.4	-640.6
2057								789.0	789.0	148.4	-640.6
2058								789.0	789.0	148.4	-640.6
2059								789.0	789.0	148.4	-640.6
2060								789.0	789.0	148.4	-640.6
Total	15,493.0	1,772.0	3,291.0	3,270.0	521.0	4,100.0	429.0				
										FIRR	#DIV/0!

Table 3.5.7 FIRR Calculation (10.5 Times)

Unit: Million FCFA

Year	Cost									Benefit	Net Benefit
	Construction Works	Physical Contingency	Consulting Services	Land Acquisition	Administration	VAT	Import Tax	O&M	Total		
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	170.0	0.0	3.0	31.0	0.0	0.0	204.0	0.0	-204.0
2016	0.0	0.0	1,494.0	1,939.0	69.0	269.0	0.0	0.0	3,771.0	0.0	-3,771.0
2017	4,766.0	531.0	527.0	1,331.0	154.0	1,146.0	139.0	0.0	8,594.0	0.0	-8,594.0
2018	7,248.0	829.0	687.0	0.0	196.0	1,765.0	224.0	242.7	11,191.7	284.8	-10,906.9
2019	3,479.0	412.0	413.0	0.0	99.0	889.0	66.0	611.8	5,969.8	802.1	-5,167.7
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	789.0	789.0	1,079.2	290.2
2021								789.0	789.0	1,122.4	333.4
2022								789.0	789.0	1,167.4	378.4
2023								789.0	789.0	1,214.1	425.1
2024								789.0	789.0	1,262.6	473.6
2025								789.0	789.0	1,312.8	523.8
2026								789.0	789.0	1,357.9	568.9
2027								789.0	789.0	1,404.4	615.4
2028								789.0	789.0	1,452.3	663.3
2029								789.0	789.0	1,501.5	712.5
2030								789.0	789.0	1,552.2	763.2
2031								789.0	789.0	1,552.2	763.2
2032								789.0	789.0	1,552.2	763.2
2033								789.0	789.0	1,552.2	763.2
2034								789.0	789.0	1,552.2	763.2
2035								789.0	789.0	1,552.2	763.2
2036								789.0	789.0	1,552.2	763.2
2037								789.0	789.0	1,552.2	763.2
2038								789.0	789.0	1,552.2	763.2
2039								789.0	789.0	1,552.2	763.2
2040								789.0	789.0	1,552.2	763.2
2041								789.0	789.0	1,552.2	763.2
2042								789.0	789.0	1,552.2	763.2
2043								789.0	789.0	1,552.2	763.2
2044								789.0	789.0	1,552.2	763.2
2045								789.0	789.0	1,552.2	763.2
2046								789.0	789.0	1,552.2	763.2
2047								789.0	789.0	1,552.2	763.2
2048								789.0	789.0	1,552.2	763.2
2049								789.0	789.0	1,552.2	763.2
2050								789.0	789.0	1,552.2	763.2
2051								789.0	789.0	1,552.2	763.2
2052								789.0	789.0	1,552.2	763.2
2053								789.0	789.0	1,552.2	763.2
2054								789.0	789.0	1,552.2	763.2
2055								789.0	789.0	1,552.2	763.2
2056								789.0	789.0	1,552.2	763.2
2057								789.0	789.0	1,552.2	763.2
2058								789.0	789.0	1,552.2	763.2
2059								789.0	789.0	1,552.2	763.2
2060								789.0	789.0	1,552.2	763.2
Total	15,493.0	1,772.0	3,291.0	3,270.0	521.0	4,100.0	429.0				
										FIRR	0.0%

Table 3.5.8 FIRR Calculation (35.5 Times)

Unit: Million FCFA

Year	Cost									Benefit	Net Benefit
	Construction Works	Physical Contingency	Consulting Services	Land Acquisition	Administration	VAT	Import Tax	O&M	Total		
2014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	170.0	0.0	3.0	31.0	0.0	0.0	204.0	0.0	-204.0
2016	0.0	0.0	1,494.0	1,939.0	69.0	269.0	0.0	0.0	3,771.0	0.0	-3,771.0
2017	4,766.0	531.0	527.0	1,331.0	154.0	1,146.0	139.0	0.0	8,594.0	0.0	-8,594.0
2018	7,248.0	829.0	687.0	0.0	196.0	1,765.0	224.0	242.7	11,191.7	967.4	-10,224.3
2019	3,479.0	412.0	413.0	0.0	99.0	889.0	66.0	611.8	5,969.8	2,724.6	-3,245.2
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	789.0	789.0	3,665.8	2,876.8
2021								789.0	789.0	3,812.5	3,023.5
2022								789.0	789.0	3,965.3	3,176.3
2023								789.0	789.0	4,124.0	3,335.0
2024								789.0	789.0	4,288.7	3,499.7
2025								789.0	789.0	4,459.4	3,670.4
2026								789.0	789.0	4,612.5	3,823.5
2027								789.0	789.0	4,770.4	3,981.4
2028								789.0	789.0	4,933.0	4,144.0
2029								789.0	789.0	5,100.4	4,311.4
2030								789.0	789.0	5,272.5	4,483.5
2031								789.0	789.0	5,272.5	4,483.5
2032								789.0	789.0	5,272.5	4,483.5
2033								789.0	789.0	5,272.5	4,483.5
2034								789.0	789.0	5,272.5	4,483.5
2035								789.0	789.0	5,272.5	4,483.5
2036								789.0	789.0	5,272.5	4,483.5
2037								789.0	789.0	5,272.5	4,483.5
2038								789.0	789.0	5,272.5	4,483.5
2039								789.0	789.0	5,272.5	4,483.5
2040								789.0	789.0	5,272.5	4,483.5
2041								789.0	789.0	5,272.5	4,483.5
2042								789.0	789.0	5,272.5	4,483.5
2043								789.0	789.0	5,272.5	4,483.5
2044								789.0	789.0	5,272.5	4,483.5
2045								789.0	789.0	5,272.5	4,483.5
2046								789.0	789.0	5,272.5	4,483.5
2047								789.0	789.0	5,272.5	4,483.5
2048								789.0	789.0	5,272.5	4,483.5
2049								789.0	789.0	5,272.5	4,483.5
2050								789.0	789.0	5,272.5	4,483.5
2051								789.0	789.0	5,272.5	4,483.5
2052								789.0	789.0	5,272.5	4,483.5
2053								789.0	789.0	5,272.5	4,483.5
2054								789.0	789.0	5,272.5	4,483.5
2055								789.0	789.0	5,272.5	4,483.5
2056								789.0	789.0	5,272.5	4,483.5
2057								789.0	789.0	5,272.5	4,483.5
2058								789.0	789.0	5,272.5	4,483.5
2059								789.0	789.0	5,272.5	4,483.5
2060								789.0	789.0	5,272.5	4,483.5
Total	15,493.0	1,772.0	3,291.0	3,270.0	521.0	4,100.0	429.0			FIRR	12.0%

3.5.3 Financial Analysis on ONAS

(1) Financial Statements of ONAS Dakar

In ONAS Kaolack office, administration is fully controlled by ONAS headquarter in Dakar and nothing can be decided by the Kaolack Office except daily routine works. Thus, financial examination should be done on ONAS Dakar. ONAS Dakar, the implementation agency of the sewerage component, issues its financial statements [Balance Sheet (B/S) and Profit-and Loss (P/L) Statement] and reports to the government every year. B/S and P/L statement of ONAS Dakar for the last four years are shown, as follows.

Table 3.5.9 Balance Sheet of ONAS Dakar

Unit: FCFA

Date	31/12/2008	31/12/2009	31/12/2010	31/12/2011
Assets				
Current Assets				
Assets of Non-Ordinary Activities	0	0	0	0
Inventries	127,729,359	120,097,138	103,488,653	93,803,542
Receivables	7,110,054,703	8,899,254,339	10,634,570,326	10,179,013,310
Cashes	4,170,349,220	4,815,432,451	6,607,740,117	7,784,775,925
Total Current Assets	11,408,133,282	13,834,783,928	17,345,799,096	18,057,592,777
Fixed Assets				
Deferred Assets	0	0	0	0
Inangible Assets	876,707,097	842,329,701	790,944,388	817,706,803
Tangible Fixed Assets	115,176,524,634	110,132,750,058	93,912,547,158	99,697,788,352
Advance Payment	891,814,002	984,234,459	1,525,396,132	1,259,831,907
Financial Assets	69,859,362	95,989,741	121,692,598	118,396,824
Total Fixed Assets	117,014,905,095	112,055,303,959	96,350,580,276	101,893,723,886
Total Assets	128,423,038,377	125,890,087,887	113,696,379,372	119,951,316,663
Equities and Liabilities				
Liabilities				
Current Liabilities				
Debts of Non-Ordinary Activities	1,198,756,712	1,080,051,355	1,247,886,786	1,766,159,940
Advanced Payment Received	219,823,981	304,041,251	439,928,036	564,278,655
Payables to Suppliers	854,988,776	1,487,666,233	1,134,720,052	1,210,920,615
Taxes	324,908,255	576,724,574	1,413,031,152	2,507,636,023
Social Security Conributions	158,335,148	242,560,144	250,631,044	350,313,898
Other Liabilities	2,103,673,574	2,099,104,432	2,102,563,978	114,551,535
Cntingency Provisions	0	0	0	0
Credit Discount by Bank	0	0	0	0
Cash Loans from Bank	0	0	0	0
Overdraft from Bank	221,135,618	565,352,911	509,509,292	593,174,707
Total Current Liabilites	5,081,622,064	6,355,500,900	7,098,270,340	7,107,035,373
Fixed Liabilities				
Borrowings	84,477,018	46,512,504	4,106,484	313,579
Leasing	0	0	0	0
Other Financial Debts	1,000,000	1,000,000	1,000,000	1,000,000
Financial Provisions for Risks and Charges	271,688,464	340,338,513	547,218,546	630,131,561
Total Fixed Liabilities	357,165,482	387,851,017	552,325,030	631,445,140
Total Liabilities	5,438,787,546	6,743,351,917	7,650,595,370	7,738,480,513
Equities				
Capital	2,328,000,000	2,328,000,000	2,328,000,000	2,328,000,000
Retained Earnings	-2,311,660,962	-1,522,034,384	-1,735,883,432	-2,007,800,248
Earned Surplus Carried Forward	789,626,578	-213,849,048	-271,916,816	589,244,176
Investment Grant	122,178,285,215	118,554,619,402	105,725,584,250	111,303,392,222
Total Equities	122,984,250,831	119,146,735,970	106,045,784,002	112,212,836,150
Total of Equities and Liabilities	128,423,038,377	125,890,087,887	113,696,379,372	119,951,316,663

Source: ONAS Dakar, modified by JICA Expert Team

Table 3.5.10 Profit-and-Loss Statement of ONAS Dakar

Unit: FCFA

Year	2008	2009	2010	2011
Operating Income				
Sales				
Sales of Goods	0	0	0	0
Sales of Products	47,812,019	48,560,450	64,446,426	56,423,729
Sales of Services	5,168,757,406	5,065,463,574	5,340,336,383	5,836,820,614
Stored Product	0	0	0	0
Capotalized Production	0	0	0	0
Other Ancillary Revenues	37,551,406	20,144,228	30,184,358	29,768,943
Total Sales	5,254,120,831	5,134,168,252	5,434,967,167	5,923,013,286
Operating Subsidies	10,123,024,108	1,747,651,050	1,232,276,517	1,336,681,375
Other Products	22,275,145	27,293,117	82,628,914	216,825,838
Reversals	1,811,414	0	14,600,035	0
Expenses Transfers	0	0	0	0
Total Operating Income	15,401,231,498	6,909,112,419	6,764,472,633	7,476,520,499
Operating Expenses				
Purchases of Goods	0	0	0	0
- Change in Inventories	0	0	0	0
Purchaes of Raw Materials	115,140,031	152,895,733	94,868,118	95,524,394
- Change in Inventories	-52,479,256	4,508,860	15,424,128	4,196,528
Other Purchases	1,313,028,294	1,767,286,429	1,685,840,537	1,558,355,911
- Change in Inventories	-8,781,270	0	0	0
Transportations	16,620,542	18,912,426	29,666,765	5,920,591
External Services	11,226,735,877	2,966,040,984	3,405,762,573	2,155,421,889
Taxes	92,307,469	143,949,037	164,917,379	1,016,312,572
Other Costs	304,227,864	212,067,191	50,964,845	652,148,448
Personnel Expenses	1,530,432,211	1,776,256,336	1,805,772,642	2,017,710,937
Depreciation and Amortizaion	3,955,591,870	4,216,292,605	4,393,012,000	4,354,188,035
Total Operting Expenses	18,492,823,632	11,258,209,601	11,646,228,987	11,859,779,305
Operating Profit	-3,091,592,134	-4,349,097,182	-4,881,756,354	-4,383,258,806
Non-Operating Income				
Financial Revenue	27,562,096	27,551,275	37,848,293	52,022,358
Foreign Exchange Gains	0	0	0	0
Reversals	0	0	0	0
Expenses Transfers	0	0	0	0
Total Non-operating Income	27,562,096	27,551,275	37,848,293	52,022,358
Non-Operating Expenses				
Finaical Costs	69,847,083	42,322,015	72,859,093	77,812,972
Forreign Exchange Losses	0	3	0	0
Amortization and Provision	0	0	547,303,131	68,153,139
Total Non-operating Expenses	69,847,083	42,322,018	620,162,224	145,966,111
Total Ordinary Profit	-3,133,877,121	-4,363,867,925	-5,464,070,285	-4,477,202,559
Non-Ordinary Profit				
Apraisal Gains of Assets	0	4,684,800	700,000	0
Gains by Non-Ordinary Activities	0	0	0	0
Reversals of Non-Ordinary Activites	3,924,503,699	4,147,458,940	5,210,684,737	5,067,446,735
Expenses Transfers	0	0	0	0
Total Non-Ordinary Profit	3,924,503,699	4,152,143,740	5,211,384,737	5,067,446,735
Non-Ordinary Loss				
Apraisal Loss of Assets	0	1,124,863	0	0
Loss by Non-Ordinary Activities	0	0	18,231,268	0
Provisions for Non-Ordinary Activites	0	0	0	0
Total Non-Ordinary Loss	0	1,124,863	18,231,268	0
Eanings before Tax	790,626,578	-212,849,048	-270,916,816	590,244,176
Income Tax	1,000,000	1,000,000	1,000,000	1,000,000
Profit after Tax	789,626,578	-213,849,048	-271,916,816	589,244,176

Source: ONAS Dakar, modified by JICA Expert Team

ONAS had been encountering operating deficits of more than 4,000 million FCFA in the last three years according to the P/L statement, which amounts to more than one half of operating income. These deficits are reduced by more than 1,000 million FCFA of operating subsidies from the government every year. The P/L statement clarifies the very low income, that is, very low sewerage charges which can be seen in the financial analysis of the project. ONAS sometimes show positive

Earnings before Tax, but they are just figures in the accounting book. Chief Accountant of ONAS explained that the subsidies from the government were mandated in case of deficit and they were not enough, so that the amounts of ordinary deficits were forecasted and these amounts had been put in Reversals of Non-Ordinary Activities in Non-Ordinary Profit.

The same story can be seen in Investment Grant of Equities in B/S. If Investment Grant is not made, Equities would be degrading dramatically because of negative Retained Earnings which amount to almost the same size of Capital every year.

Very low sewerage charges can be clarified from the viewpoint of "Total Asset Turnover" (= [Sales] ÷ [Total Assets]), which shows how efficiently the assets are utilized to realize the sales revenue. It means that if the figure is less than 1, some part of assets does not contribute to make sales mainly due to very low revenues. Total Asset Turnover of ONAS is 0.04 to 0.05, which means that the all assets will contribute to realize the sales revenue in 20 to 25 years.

Since the sewerage charge is levied together with the water charge of SDE, the sewerage charge revenue would increase if water charge revenue increased. There are two ways for increasing the water charge revenue, namely; one is to increase water tariff and the other is to decrease non-revenue water. Increase in water tariff is very difficult due to a political reason. Decrease in non-revenue water is also very difficult because the non-revenue rate is presently around 20%, which is very low, compared with other developing countries, for example 40% in Pakistan.

(2) Simplified Cost Simulation

Simplified cost simulation was conducted in order to investigate future costs through the project implementation and operation and maintenance taking into consideration the loan cost (principal repayment and interest payment) from the viewpoint of the project implementation agency, ONAS.

[Assumptions for the Simulation]

1. Costs for eligible items (Construction Works, Price Escalation, Physical Contingency, and Consulting Services) are financed by loan.
2. Costs for eligible items (Cash Outflow) are simply offset by loan disbursement for them (Cash Inflow); hence these two cash flows are cancelled and do not appear in the simulation.
3. Loan conditions are as follows: Maturity 30 years, Grace Period 10 years, Interest Rate 1.4% for Construction Works, Price Escalation and Physical Contingency, and 0.01% for Consulting Services.
4. Simulation period is from 2014 to 2050 when the principal repayment is fully made.
5. Costs for non-eligible items (Land Acquisition, Administration, VAT, Import Tax, Loan Cost, and Operation and Maintenance) are financed by ONAS's own fund or a subsidy by the Government.
6. Other taxes and charges levied are not considered in the simulation.

The simulation result is shown in **Table 3.5.11**. Yearly cost total peaks at 2,173 million FCFA for 2030 in the period after the construction is completed. The maximum amount is 2,899 million FCFA for 2017 mainly due to land acquisition and VAT payment. Principal repayment exceeds 1,000 million FCFA for the 18 years from 2030 to 2047.

Table 3.5.11 Simplified Cost Simulation

Unit: Million FCFA

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Project Cost (Non-Eligible for Loan)																			
Land Acquisition	0.00	0.00	1,939.00	1,331.00	0.00	0.00	0.00												
Administration Cost	0.00	3.00	69.00	154.00	196.00	99.00	0.00												
VAT	0.00	31.00	269.00	1,146.00	1,765.00	889.00	0.00												
Import Tax	0.00	0.00	0.00	139.00	224.00	66.00	0.00												
Project Cost (Non-Eligible) Total	0.00	34.00	2,277.00	2,770.00	2,185.00	1,054.00	0.00												
Operation and Maintenance	0.00	0.00	0.00	0.00	242.71	611.83	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00
Loan Cost																			
Repayment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.50	83.20	401.50	891.75	1,138.75	1,138.75	1,138.75
Interest	0.00	0.02	0.17	81.97	209.69	273.11	273.11	273.11	273.11	273.11	273.11	273.11	273.10	273.10	269.00	258.51	244.86	231.20	217.55
Front-end Fee	0.00	47.00	47.00	47.00	47.00	47.00	47.00												
Loan Cost Total	0.00	47.02	47.17	128.97	256.69	320.11	320.11	273.11	273.11	273.11	273.11	273.11	281.60	356.30	670.50	1,150.26	1,383.61	1,369.95	1,356.30
Cost Total	0.00	81.02	2,324.17	2,898.97	2,684.40	1,985.93	1,109.11	1,062.11	1,062.11	1,062.11	1,062.11	1,062.11	1,070.60	1,145.30	1,459.50	1,939.26	2,172.61	2,158.95	2,145.30

Year	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Project Cost (Non-Eligible for Loan)																		
Land Acquisition																		
Administration Cost																		
VAT																		
Import Tax																		
Project Cost (Non-Eligible) Total																		
Operation and Maintenance	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00	789.00
Loan Cost																		
Repayment	1,138.75	1,138.75	1,138.75	1,138.75	1,138.75	1,138.75	1,138.75	1,138.75	1,138.75	1,138.75	1,138.75	1,138.75	1,138.75	1,130.25	1,055.55	737.25	247.00	0.00
Interest	203.89	190.24	176.58	162.93	149.27	135.62	121.96	108.31	94.65	81.00	67.34	53.68	40.03	26.37	12.73	3.17	-0.00	-0.00
Commitment Charge																		
Loan Cost Total	1,342.64	1,328.99	1,315.33	1,301.68	1,288.02	1,274.37	1,260.71	1,247.06	1,233.40	1,219.75	1,206.09	1,192.43	1,178.78	1,156.62	1,068.28	740.42	247.00	-0.00
Cost Total	2,131.64	2,117.99	2,104.33	2,090.68	2,077.02	2,063.37	2,049.71	2,036.06	2,022.40	2,008.75	1,995.09	1,981.43	1,967.78	1,945.62	1,857.28	1,529.42	1,036.00	789.00

3.6 Environmental Impact Assessment Study

3.6.1 Description of the Component

This component essentially consists of:

1) Improvement of sewage system including the installation of the main collector as well as the new construction of pumping stations
2) Expansion and rehabilitation of sewage treatment plants

3.6.2 Activities Requiring Environmental Consideration

Main activities requiring environmental consideration are as follows:

- Demolition of asbestos cement pipes
- Evacuation
- Installation of new pipes
- Rehabilitation (expansion) and construction of pumping stations, wastewater/sludge treatment plants.

3.6.3 Project Area Outlook and Scopes of Assessment

(1) Sewage Treatment Plant (STP) in Koundam

The existing STP project site as well as its expansion site is located in Koundam District, where 279 households with 2,322 people reside. This area is a part of urbanization zone of Kaolack City, which includes the administrative and commercial areas. The expansion of STP site is planned in the industrial area of Koundam District. There is a recycling plastic factory in the industrial area, but a large part of it is bare land. The City Government plan to establish a protected beach in Koundam District, which is located next to the largest tourist hotel (Hotel Relais) in Kaolack City and the existing STP site. No specific concerns like ethnic groups, national or natural parks, precious wildlife and historical memorials have been observed over the area.

(2) Pumping Station in Darou Salam Ndangane

The planned pumping station is located at Garage Nioro in Darou Salam Ndangane District, a center of commercial and industrial area in south-east of Kaolack City. The location of the site is about 200 m far from a market and 100 m from the main road to Nioro. The place is muddy area with a lot of solid wastes. According to the neighboring residents, nobody has been lived in the site. A workshop for dump trucks is next to the site. In the area, concerns mentioned in the STP in Koundam have not been detected.

(3) Pumping Station in Boustane

A pumping station is planned in Boustane, the western periphery of Kaolack City and the right side of trunk road (R1) to Dakar. The area is one of the centers of transportation in Kaolack City, and there is a bus terminal station in the south side of the R1. The planned site belongs to the area of an Islamic school inside of the R1. In the area, concerns mentioned in the other works above have not been detected, either.

3.6.4 Considerations on Natural and Social Environment

Possible adverse impacts on both natural and social environment by the sewerage/sanitation system improvement during construction and operation phases are summarized in **Table 3.6.1**.

Table 3.6.1 Possible Adverse Impacts by Sewerage/Sanitation System Improvement

Phase	Impact	Intensity	Extended	Importance
Natural Environment				
Construction	Scattering of waste debris in the site	Low	Local	Minor
	Soil contamination by sewage spills or waste oil			
	Water contamination by infiltrated sewage			
	Odor nuisance (H_2S)			
	Temporary displacement of wildlife			
	Degradation of air quality			
Operation	Contamination of soil, surface/ground water by the waste water discharged from the site	Strong		Major
	Odor nuisance			
	Losses and occasional release of wastewater during malfunction of the river			
	Pouring of wastewater from the ponds by defective sealing walls			
Social Environment				
Construction	Inhalation of asbestos (high exposure)	Low	Local	Minor
	Momentary interruption of sewage service on the existing network			
	Outbreak of infectious diseases (mainly by contaminated water)			
	Traffic jam and accidents	Strong		Major
	Destruction of public infrastructure			
Operation	Odor during the winter season			
	Contamination of the river by sporadic spurts during mechanical malfunction or power failure at the site.			

Based on the possible adverse impacts by sewerage/sanitation system Improvement, the mitigation and minimizing measures as well as monitoring plans are proposed. The following table summarizes the mitigation and minimizing measures as well as the monitoring plans, focusing on the items of "Intensity is Strong and Importance is Major". All the proposed mitigation/minimizing plans as well as monitoring plans are attached in Appendix.

Table 3.6.2 Mitigation/Minimizing Measures and Monitoring Plan of Sewerage/Sanitation System Improvement

Phase	Impact	Mitigation/Minimizing Measures	Monitoring Plan
Natural Environment			
Operation	Contamination of soil and surface or groundwater by wastewater discharged from the site	• To install stand-by facilities such as pump and by-pass pipe to divert wastewater to another channel or treatment unit so as not to contaminate the soil and surface water around the STP site. • To form a lining on the surface of the lagoons. • To keep water-tightness of the discharge pipe.	Water quality analysis (such parameters as BOD_5, COD_{Cr}, TSS, fecal coliform) [Frequency: at least 4 times in a year]
	Odor or foul smell (which is predicted especially in the STP site)	• To lay out aerated lagoons which are the major sources of odor or foul smell in the sedimentation lagoon expansion area of the STP. • To plant trees such as Eucalyptus along the boundary of STP site.	Interview with the inhabitants around the STP site [Frequency: when required]
	Losses and occasional release of wastewater during malfunction of facilities.	• To install standby facilities such as pump and bypass pipe to divert wastewater to another channel or treatment unit. • To install electric power generators for	Observation of the facilities [Frequency: everyday]

Phase	Impact	Mitigation/Minimizing Measures	Monitoring Plan
		emergency use.	
	Spillage of wastewater from the ponds by defective sealing walls	• To install electric power generators for emergency use.	Check the surface of the lagoons [Frequency: once a year]
Social Environment			
Construction	Traffic jams and accidents	• To remove and transport excavated soil as fast as possible. • To establish diversion road, traffic signs, boards and warning lights at the construction site.	Observation of traffic volume and traffic jams [Frequency: once every 3 months]
	Destruction of public infrastructure	• To minimize the excavated area on public roads especially in installing sewer pipes. • To utilize temporary materials such as sheet piles as far as practicable.	Observation [Frequency: once every 3 months]
Operation	Odor or foul smell during winter season	• To lay out aerated lagoons which are the major sources of odor or foul smell inside the sedimentation lagoon expansion area of the STP. • To plant trees such as Eucalyptus along the boundary of the STP site.	Interview with the inhabitants around the STP site [Frequency: when required]
	Contamination of river by sporadic spurts of smoke or gas during malfunction of mechanical equipment or power failure)	• To install stand-by facilities such as pump and by-pass pipe to divert wastewater to another channel or treatment unit so as not to contaminate soil and surface water around the STP site. • To install generators for the emergency use.	Observation [Frequency: when malfunction of facilities occur]

3.6.5 Alternatives "With Project" (Analysis of the EIA report)

(1) Sewerage System Improvement

(a) Site Selection for Expansion of STP

EIA report compares the expansion areas of STP with two alternatives and selects "Site No. 1 (neighboring area of existing STP)" as suitable area for expansion of the STP, as shown in **Table 3.6.2**.

Table 3.6.3 Comparison of Expansion Area of STP

Site	Evaluation
Site No. 1 (Industrial area in Koundam)	Since the site is near the existing STP, long connecting pipes are not needed. Currently, most of the land belongs to the State Government. In case of malfunction of the existing STP, the risk of pollution may be less than that in "Site No. 2". Since this site is located in the center of Kaolack City, there is concern about offensive odor to the neighborhood. Also, some plots of land belong to the local people.
Site No. 2 (Army Shooting Range in Koundam)	This site is located in an open area in Koundam. Connection from this site to the network behind Ngadé in Koundam Subdivision may be possible. However, investment cost is higher due to the 1 km distance from the existing STP. Since the land now belongs to the Army, the possibility of obtaining the land from the Army may be low. There is risk of contamination in case of failure of connecting pipes.

(b) Sewage Treatment Method for Expansion Area of STP

The EIA report compares sewage treatment method, focusing on 1) aerated lagoon, 2) lagoon and 3) activated sludge process.

As shown in **Table 3.6.3**, aerated lagoon is recommended because: 1) enough land is not available in the expansion area to apply lagoon system and 2) activated sludge process needs high energy consumption.

Table 3.6.4 Comparison of Sewage Treatment Method Applicable to Expansion area of STP

Method	Evaluation
Aerated Lagoons (Proposed method in F/S)	Energy consumption is higher than that in lagoon system. However, this can be offset by a small required area and more possibility of treated wastewater for reuse.
Alternative 1 (Lagoons)	Lagoon system consumes no energy and investment cost is low. However, this method requires a large area.
Alternative 2 (Activated sludge process)	This alternative requires a smaller area than the others. However, energy, construction and maintenance costs are quite high.

(c) Sludge Treatment for Expansion Area of STP

The EIA report evaluates the most favorable sludge treatment method. As shown in **Table 3.6.4**, the sedimentation basin and drying beds is recommended for sludge treatment considering land requirement and workload for O&M.

Table 3.6.5 Comparison of Sludge Treatment Method Applicable to Expansion Area of STP

Method	Evaluation
Sedimentation basin and drying beds (Proposed method in F/S)	Removal rate of BOD_5, COD_{Cr} and TSS is high. The volume of sludge is small after treatment. However, maintenance works for pumps and pipes are needed.
Alternative 1. (Unplanted drying beds)	O&M is easy. Removal rates of BOD_5, COD_{Cr} and TSS are high. However, the volume of sludge is large with liquid portion and need a long time to dry sludge.
Alternative 2 (Constructed wetlands: planted drying beds)	It might be good for landscape and odor is reduced. However, removal rate will depend on the variety of plants, and additional activities are needed to keep the plants in healthy condition.

(2) Additional Alternatives for Cleaning up of Neighboring Koundam District

The EIA report also compares two alternatives for sanitation projects neighboring the STP site in Koundam district indicated in **Table 3.6.5**, because installation of sewer network in this district is not included in the priority projects.

Alternative 2 has been implemented on a large scale by ONAS since 2004 in PAQPUD. It covers villages of Camberene, Ngro, Ougman, Yoff, Hanbel air, and Bargny, located in the neighboring area of Dakar.

The EIA report recommends Alternative 2 for neighboring Koundam district and estimates investment and operation costs of 12,550,000 and 2,790,000 FCFA (for the number of households: 279).

Table 3.6.6 Alternative for Koundam District

Alternative	Evaluation
1. Conventional sewerage	The system can be controlled properly by operator (ONAS). However, it is expensive and it is difficult for low-income people to enjoy the service.
2. Communal septic tank with small diameter sewer system	The system requires easy operation and maintenance. Desludging of the septic tank needs once in several years. However, it requires regular monitoring network and an organization for the management works.
	Maintenance: - Periodical maintenance of sewer and manholes - Periodical desludging and maintenance of communal septic tank

3.6.6 Environmental Management and Monitoring

Environmental management and monitoring plan with mitigation measures are attached in "Appendix".

3.6.7 Roles of Implementing Agencies and Legal Framework

Roles of implementation agencies and legal framework are described in "Appendix".

3.7 Implementation Program

3.7.1 General

The Implementation Program is formulated in consideration of feasible construction procedure to complete all the construction works and the subsequent cost estimate by the target year 2020. The implementation program for the proposed project is based on the following:

- Assumed commencement month of project is November 2014.
- Project needs to be completed by the target year of 2020.

3.7.2 Basic Condition

Loan project for sewerage and sanitation facilities is assumed to consider the implementation program. The following assumed duration before the construction project is based on the information from WB, AfDB, IDB, etc.

- Fund arrangement (E/N, L/A) and procurement of consultant: 12 months
- Detailed Design, Tender and the contract of the Contractor: 18 months

To decide the duration of project construction work, the standard productivity published by the Ministry of Land, Infrastructure, Transport and Tourism in Japan and also the JICA cost estimation manual is referred.

3.7.3 Implementation Plan

To study the implementation plan for sewerage and sanitation facilities, the following points shall be taken into account.

- As stated in **Sub-section 2.1.4** of the Master Plan, annual rainfall in Kaolack, which mainly occurs between July and September, is about 560 mm. During the rainy season, monthly rainfall is about 120 mm to 220 mm. From the data, compared to Japan or Southeast Asian Countries, rainfall amount is much less. In the proposed project, major civil works for sewerage and sanitation facilities are earth works. Therefore, it is expected that rainfall during the three months of rainy season will cause the deterioration of productivity. In addition, there are a lot of public holidays (14 days/year) in Senegal. However, in general, there are no special conditions which tremendously affect productivity. In conclusion, work stop coefficient of 1.35, which is applied for normal condition, is used based on the JICA cost estimation manual. Besides, regional coefficient for labor and equipment, that is, 2.0 for simple labor works, 3.5 for skilled labor works and 70% for the works by machineries in a region of Africa, is applied.
- In principle, the works for sewer network shall be carried out from downstream to upstream.

- The works for sewer networks, pumping stations and sewage treatment plant shall be commenced concurrently so that it will be possible to complete the overall works within 30 months. In addition, the works for branch sewer, which are not included in the scope of this Project, will also be possible to proceed concurrently within 30 months. However, in such a case, the coordination between both projects is required in terms of the construction schedule to minimize the unfavorable effect to the existing traffic flow and to avoid the risk of accidents due to overlapped or closed work areas.
- Judging from the work volume and sequence, the construction works of a total length of 18 km sewer network is apparently the critical path. The following are the working sequence for the construction of sewer networks.

1) Demolition of existing asphalt road
2) Excavation
3) Backfilling by imported sand below sewer line
4) Pipe laying
5) Backfilling surrounding pipe
6) Backfilling by using the selected excavated soil
7) Granular sub base course
8) Aggregate base course
9) Wearing course

3.7.4 Consultancy Services

(1) Objectives

The objectives of the consulting engineering services are to carry out the following:

- The detailed design works, including cost estimation;
- Pre-construction phase services including the review of tender documents;
- Construction supervision including the environmental monitoring;
- Technical assistance for operation and maintenance works including the preparation of manuals and implementation of training on appropriate operation and maintenance after the construction; and
- Technology Transfer.

(2) Scope of Services

(a) The Detailed Design Phase

Review and Evaluation

This will cover the review of the previously prepared plan and the study results to identify the main points that require further investigation for the preparation of the detailed design.

Survey and Study

(i) Data Collection

To update the required information and data, the following data are to be collected and analyzed:

1) Topography: Topographic map with 1 m contour interval.
2) Geology and Soil Mechanics.
3) Socio-economy: Census data, population growth rate, future urban development, existing assets and property, road and other public facilities.
4) Existing Sewerage Facilities: Sewage treatment plant, pumping stations and sewers.
5) River Condition: Saloum River.

(ii) Survey and Investigation

To provide the data required for the design of facilities, the following survey and investigations are to be carried out:

1) Topographic Survey
   - Topographic survey for sewage treatment plant of (i) existing lagoon area (7.0 ha) and (ii) expansion area of aerated lagoon, septage treatment facilities, including their adjacent area (12.0 ha) and their adjacent area, totaling 19.0 ha.
   - Topographic survey for pumping stations of PS Boustane, PS Darou Salam Ndangane, PS No.2 and PS No.3 (0.3 ha)
   - Route survey for sewer lines (19.0 km long; 30 m wide)
   - Cross-section and longitudinal profile (19.0 km; 50 m interval)

2) Geotechnical Investigation
   - Core boring at site of sewage treatment plant (6 holes, 30 m depth each)
   - Core boring at site of pumping stations (2 holes, 20 m depth each)
   - Core boring at site of sewer lines (18 holes, 10 m depth each)
   - Soil mechanics test (66 samples)

3) Structural Survey
   - Exact location and dimension of existing sewage treatment plant.
   - Exact location and dimension of existing pumping stations.

(iii) Future Demand Projection

The following analyses are to be done to formulate the definitive plan and design conditions:

- Wastewater Generation per Capita: Domestic water consumption, commercial and administrative water consumption, wastewater generation ratio, groundwater inflow and connection ratio.
- Pollution Load Generation

(iv) Hydraulic Analysis

The following hydraulic analyses are to be done to formulate the definitive plan and design conditions:

- Hydraulic Analysis: Confirmation of pump capacity, flow capacity of sewer lines and other related matters.

(v) Structural Analysis

For the detailed structural design, structural analyses for the sewage treatment plant, pumping stations and major facilities are to be carried out, as follows:

- Soil Mechanics: Consideration and analysis for pile driving for pumping stations, and sewage treatment plant.
- Stability Analysis: Stability analysis for concrete structures.

Formulation of Definitive Plan

Based on the analysis, the definitive plan will be formulated including the following:

1) Review of the proposed sewerage structures/facilities;
2) Preliminary design of the required structures and facilities;
3) Preliminary cost estimates, and benefit calculation;
4) Economic analysis; and

5) Determination of the definitive sewerage improvement plan.

Detailed Design

The detailed design with complete hydraulic and structural computations, drawings, bill of quantities, detailed cost estimates, specifications, pre-qualification documents and tender documents will be carried out for the following works:

(i) Preparatory Works

1) Access road, workshop and warehouse
2) Water and electricity supply
3) Field laboratory and safety facilities

(ii) Civil Works

1) Construction of new sewage treatment plant
2) Rehabilitation of existing sewage treatment plant
3) Construction of sewer lines
4) Improvement of existing pumping stations
5) Construction of new pumping stations

Preparation of Environmental Monitoring

1) Formation of multipartite monitoring team
2) Preparation of monitoring program
3) Establishment of environmental monitoring and management system

Institutional Improvement Study

Institutional Improvement Study includes the following items:

1) Plan for institutional strengthening of related organizations
2) Operation and maintenance institutions
3) Financial plan for related organizations

(b) Pre-construction Phase

The following matters shall be undertaken in the pre-construction stage:

- Assistance to ONAS on the acceptance and evaluation of pre-qualification received from the applicants; and
- Assistance to ONAS on the acceptance and evaluation of tender documents from tenderers.

(c) Construction Phase

The Consultant will assist ONAS in the supervision of the project construction including but not limited to the following:

Construction Supervision

1) Review and endorsement of proposed plans, designs, schedules and documents related to project implementation and construction which are submitted for approval by the Contractor;
2) Monitoring and reporting to ONAS on the progress of the work and accomplishment in relation to the schedule.
3) File inspection of works as deemed necessary by the Consultant for performance and quality control of works for the Contractor.
4) Establishment of procedures for testing of construction materials and evaluation of tests conducted by the Contractor;

5) Inspection and testing of materials, manufacture of products and equipment used in the Project.
6) Verification of Contractor's survey, sounding and setting measurements of quantity for interim and final payment.
7) Recommendation to ONAS on the acceptance or rejection of the works, in whole or in part, in accordance with the specifications or conditions of contracts.
8) Supervision and inspection of the work for adherence to plans and specifications;
9) Supervision of additional field investigations when required;
10) Advice on the method of measurement and computation of work, and assistance in the verification of contract progress and payment; and
11) Supervision of the preparation of as-built drawings by the contractor.

Design Modification

The Consultant shall make revisions, modifications and/or adjustments of designs from time to time and as necessary in accordance with actual field conditions and the comments of ONAS.

Operation and Maintenance Manual

The Consultant shall prepare the operation and maintenance manual of project facilities.

Environmental Monitoring and Management

The Consultant shall carry out environmental monitoring, evaluation and management during the construction stage.

(3) Reporting

The Consultant shall prepare and submit the following reports and documents to ONAS:

1) Bimonthly Progress Report (20 copies), to present the details of expert personnel mobilization, progress of work, financial man-month used, problems encountered and the anticipated services for the next period of services.
2) Inception Report (20 copies), one (1) month after the commencement of the services, to present the detailed work plan and program of the services including recommendations for possible alternative plans and/or designs, if any, for discussion.
3) Definitive Plan Report (20 copies), four (4) months after commencement of the services, to summarize all the works after completion of the survey, investigation and study on the optimum sewerage and sanitation system including the review of the previous plan.
4) Detailed Design Report (30 copies), twelve (12) months after commencement of the services, to compile all the results of the detailed design works, cost estimation and tender documents. The comments of ONAS shall be given to the Consultant within two (2) weeks after receiving the report.
5) Pre-qualification Evaluation Report (10 copies), two (2) weeks after receipt of Pre-qualification Documents from prospective Applicants, to present the results of the evaluation and to select the qualified applicants.
6) Tender Evaluation Report (10 copies), one (1) month after tender-opening, to present the results of the tenders to select the most responsible contractor.
7) Operation and Maintenance Manual (20 copies), containing technical procedures for the appropriate operation and maintenance of all project facilities.
8) Environmental Monitoring and Management Report (20 copies), every six (6) months after the commencement of the services, presenting the environmental evaluation and management during and after the construction stage.
9) Service Completion Report (50 copies), at the completion of all the consulting engineering services, giving a summary of the services provided and the construction works completed, including as-built drawings of the Project.

(4) Work Schedule

A total of 48months of consulting engineering services will be required for the Project. Each component of the services, namely; the detailed design, preconstruction, construction and transfer of knowledge shall be completed within the time specified, as follows:

1)	Detailed Design	12 months
2)	Pre-construction	6 months
3)	Construction	30 months
4)	Transfer of Knowledge	1 month

(5) Experts Required

For the consulting engineering services, a total of 290.4 man-months are required for foreign and local consultants as tabulated below.

Table 3.7.1 Experts Required

Item No.	Designation	Man-Month
A.	**Foreign Consultant**	
(1)	Project Manager	21.0
(2)	Sewage Treatment Plant Engineer I	10.4
(3)	Sewerage Engineer I	11.4
(4)	Structural Engineer I	8.0
(5)	Geologist/Soil Material Engineer I	4.0
(6)	Mechanical Engineer I	2.0
(7)	Electrical Engineer I	2.0
(8)	Architect I	2.0
(9)	Cost Estimator I	4.0
(10)	Project Economist I	3.0
(11)	Contract Specialist I	3.0
(12)	Construction Engineer I	32.0
(13)	Survey Expert I	4.0
(14)	Environmentalist I	4.0
(15)	Institutional Specialist I	3.0
	Total for A	113.8
B.	**Local Consultant**	
(1)	Co-Project Manager	21.0
(2)	Sewage Treatment Plant Engineer II	10.4
(3)	Sewerage Engineer II	10.0
(4)	Structural Engineer II	9.4
(5)	Geologist/Soil Material Engineer II	9.0
(6)	Mechanical Engineer II	4.4
(7)	Electrical Engineer II	4.4
(8)	Architecture II	3.0
(9)	Cost Estimator II	6.0
(10)	Project Economist II	4.0
(11)	Contract Specialist II	4.0
(12)	Construction Engineer II	15.0
(13)	Survey Expert II	6.0
(14)	Quality Control Engineer	28.0
(15)	Quantity Surveyor	30.0
(16)	Environmentalist II	9.0
(17)	Institutional Specialist II	3.0
	Total for B	176.6
	Total for A + B	290.4

3.7.5 Implementation Schedule

Based on the descriptions in the preceding sub-section, the detailed implementation schedule is formulated, as shown in **Fig. 3.7.1**.

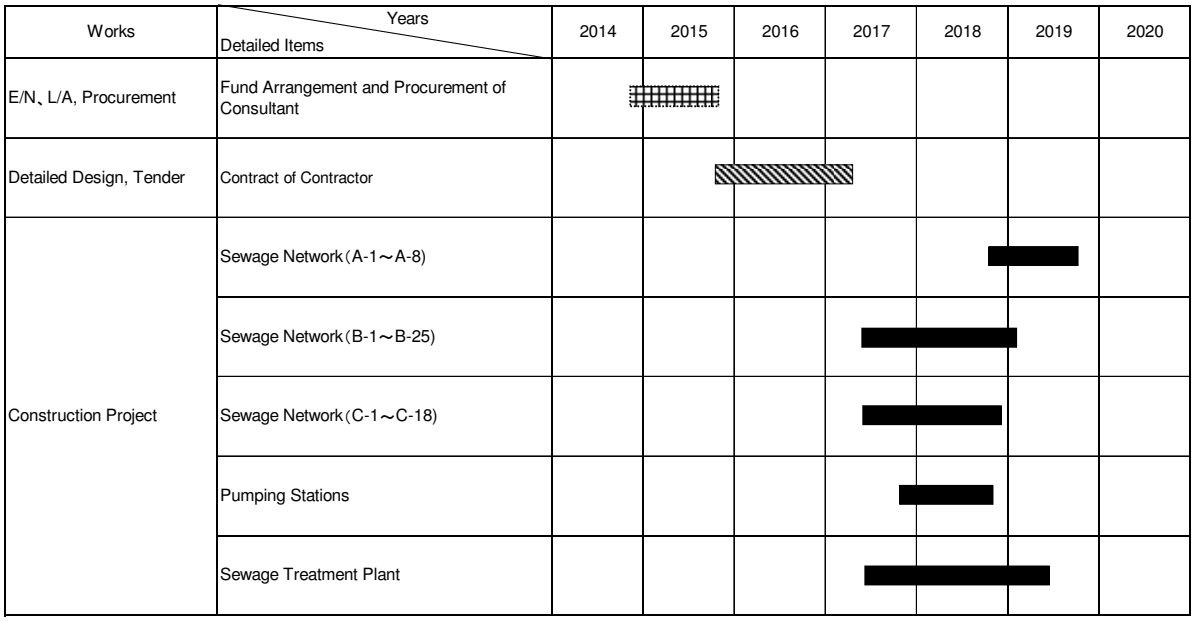


Fig. 3.7.1 Implementation Schedule of Sewerage/Sanitation Improvement Facilities

3.7.6 Disbursement Schedule

Based on the implementation schedule, the cost disbursement schedule is proposed as shown in **Table 3.7.2**(Construction Cost) and **Table 3.7.3** (Overall Project Cost).

Table 3.7.2 Cost Disbursement Schedule for Sewerage/Sanitation Improvement facilities (Construction Cost)

(million FCFA)

Item		Total			2014			2015			2016			2017			2018			2019		
		FC	LC	Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total
a.	Trunk Sewer	0	5,774	5,774	0	0	0	0	0	0	0	0	0	0	1,815	1,815	0	2,815	2,815	0	1,144	1,144
b.	Pumping Stations	386	213	599	0	0	0	0	0	0	0	0	0	89	49	138	297	164	461	0	0	0
c.	Sewage Treatment Plant	3,554	5,566	9,120	0	0	0	0	0	0	0	0	0	1,211	1,602	2,813	1,752	2,220	3,972	591	1,744	2,335
	Total	3,940	11,553	15,493	0	0	0	0	0	0	0	0	0	1,300	3,466	4,766	2,049	5,199	7,248	591	2,888	3,479

Table 3.7.3 Cost Disbursement Schedule for Sewerage/Sanitation Improvement facilities (Project Cost)

(million FCFA)

Item		Total			2014			2015			2016			2017			2018			2019		
		FC	LC	Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total
a.	Construction Works	3,940	11,553	15,493	0	0	0	0	0	0	0	0	0	1,300	3,466	4,766	2,049	5,199	7,248	591	2,888	3,479
b.	Price escalation	395	1,824	2,219	0	0	0	0	0	0	0	0	0	107	435	542	213	828	1,041	75	561	636
c.	Physical contingency	434	1,338	1,772	0	0	0	0	0	0	0	0	0	141	390	531	226	603	829	67	345	412
d.	Consulting services	1,164	2,127	3,291	0	0	0	78	92	170	633	861	1,494	179	348	527	155	532	687	119	294	413
e.	Land Acquisition	0	3,270	3,270	0	0	0	0	0	0	0	1,939	1,939	0	1,331	1,331	0	0	0	0	0	0
f.	Administration cost	0	521	521	0	0	0	0	3	3	0	69	69	0	154	154	0	196	196	0	99	99
g.	VAT	0	4,100	4,100	0	0	0	0	31	31	0	269	269	0	1,146	1,146	0	1,765	1,765	0	889	889
h.	Import Tax	0	429	429	0	0	0	0	0	0	0	0	0	0	139	139	0	224	224	0	66	66
i.	Interest during Construction	571	0	571	0	0	0	0	0	0	0	0	0	82	0	82	211	0	211	278	0	278
j.	Front-end Fee	47	0	47	0	0	0	47	0	47	0	0	0	0	0	0	0	0	0	0	0	0
	Total	6,551	25,162	31,713	0	0	0	125	126	251	633	3,138	3,771	1,809	7,409	9,218	2,854	9,347	12,201	1,130	5,142	6,272

3.8 Operation and Effect Indicators

Operation and effect indicators are set up to evaluate impact of project implementation quantitatively and qualitatively. In order to evaluate the impact of implementing the priority project in the field of sewerage and sanitation improvement, the indicators with the target year of 2022 (two years after the completion of the projects), are as set up in the following table.

Table 3.8.1 Operation and Effect Indicators

Operation and Effect Indicators	Unit	Year		Remarks
		2012 (Present)	2022 (Target Year)	
(1) Operation indicators				
Population treated by sewerage facilities	person	17,330	91,600	
Population treated by septage facilities	person	-	118,800 [1)]	
Rate of facilities utilization (STP)	%	Overloaded	47	
Influent BOD_5 concentration	mg/l	377	454	
Effluent BOD_5 concentration	mg/l	88	40	
BOD_5 treatment efficiency	%	77	91	
(2)-1 Effect indicators (For Project area)				
Percentage of population served	%	30	75	
Percentage of population connected	%	15	68	
Total length of trunk sewer	km	7.96	20.61	
(2)-2 Effect indicators (For Entire City Center)				
Percentage of population served	%	13	36	
Percentage of population connected	%	6	28	
Total length of trunk sewer	km	13.61	26.26	

Note: All values of 2022 are obtained by interpolation method using values of 2020 and 2025 in implantation plan of Master Plan. Population of project area includes that of existing serviced area.
1) This value is equivalent to 50% of people in on-site sanitation area. This 50% is the present percentage of people using on-site sanitation, which was obtained through the interview with the related agencies and NGOs.

3.9 Project Evaluation

Based on the above discussion, the priority projects of sewerage and sanitation improvement are evaluated as follows:

- Sewage treatment capacity of 15,000m^3/day and the area covered by trunk sewer of 848 ha are obtained by the construction of sewerage facilities of trunk sewer, pumping station and sewage treatment plant. As a result, sanitation condition in the area could be improved gradually and significantly in combination with branch sewer installation. ONAS is to be responsible for the branch sewer installation. Financial assistance for the branch sewer installation is expected from the donors such as the WB and/or the Government of Senegal through ADM, which are involved in related sewerage project in Kaolack. The construction of septage treatment facilities is also beneficial to the people in the on-site sanitation area.
- Technologies in operation and maintenance applied to pumping station and sewage treatment plant are technically sound because all the proposed pumping stations use the submergible type of pump which is already employed in the existing pumping stations and sewage treatment plant are designed based on lagoon and aerated lagoon which are the most simplified treatment methods.
- No resettlement is required since all proposed facilities are constructed and/or installed under public roads or vacant areas.
- During construction stage, negative impacts such as traffic interruption especially in installing sewer pipe, as well as noise, dust and vibration, would be unavoidable. However, the impacts could be minimized by introducing countermeasures such as setting up diversion road, sprinkling water and selecting low-noise and/or low-vibration type construction equipment as far as practicable.
- To implement the priority projects, financial assistance by the Government of Senegal is inevitably required.
- Considering low connection ratio of sewer network in Kaolack City, house connection of sewer network should be accelerated by financial assistance of Government of Senegal to optimize the

sewerage system. The typical cost of pipe from house inlet to inside of household (50,000 to 100,000 FCFA), which is equivalent to about 42 to 83% of the average monthly income of 120,000 FCFA/household, will creates a financial burden to each household. Under the circumstances, financial assistance from the Government of Senegal is required to improve the low connection ratio of sewer network in Kaolack City.

- Administrative advice by ONAS as well as Kaolack City to the companies providing desludging service, is strongly recommended to make them utilize septage treatment facilities and thus to reduce their desludging service charge to each household.

CHAPTER 4. STORMWATER DRAINAGE MANAGEMENT PLAN

4.1 General

4.1.1 Introduction

The Feasibility Study has been conducted on the Priority Projects identified in the Master Plan for the storm water drainage management plan in Kaolack City. The Master Plan has selected the Priority Projects to reduce flood and inundation damage at the severely inundated areas in the north area.

The Kaolack City Hall had already installed a drainage system consisting of drainage pipes, open canals and manholes to mitigate flood and inundation damage in the city center. However, the existing drainage facilities require improvement works, and there is no storm water drainage system in other areas. Therefore, the Master Plan has proposed the improvement of the existing drainage facilities, the construction of new drainage facilities and the improvement of the O&M organization/activities.

4.1.2 Component of the Priority Projects

The priority projects consist of the following components:

Table 4.1.1 Priority Project Components for Feasibility Study

Facilities		Specifications (Width × Height, Length)	Remarks
Box Culvert	N-0	1.7m × 1.7m, L= 761.5 m	New Construction
	N-1	2.0m × 1.8m, L= 568.2 m	
	N-2	1.2m × 1.2m, L= 970.5 m	
	N-3	2.2m × 2.0m, L= 711.1 m	
	N-4	1.6m × 1.6m, L=1,151.5 m	
	N-5	2.5m × 2.4m, L= 859.6 m	
	N-6	2.7m × 2.6m, L=1,265.5 m	
	N-9	2.9m × 2.9m, L= 374.3 m	
	N-PE	(2.1m × 1.6m) × 3, L=1,619.5 m	
Pumping Station (P_N)		No. of Pumps: 5 units × 3.2 m^3/s Required area: 4,300 m^2 Pump Total Head: 3.2 m	New Construction
Retention Pond		Gross storage capacity: 39,000 m^3 Bottom surface area: 14,250 m^2 Depth of pond: 2.5 m	New Construction

In the Feasibility Study stage, topographic survey was conducted for the preliminary design of priority project components. Therefore, the specifications for drainage facilities which set in the Master Plan stage have changed.

The location of proposed drainage facilities are as indicated in **Fig. 4.1.1**.

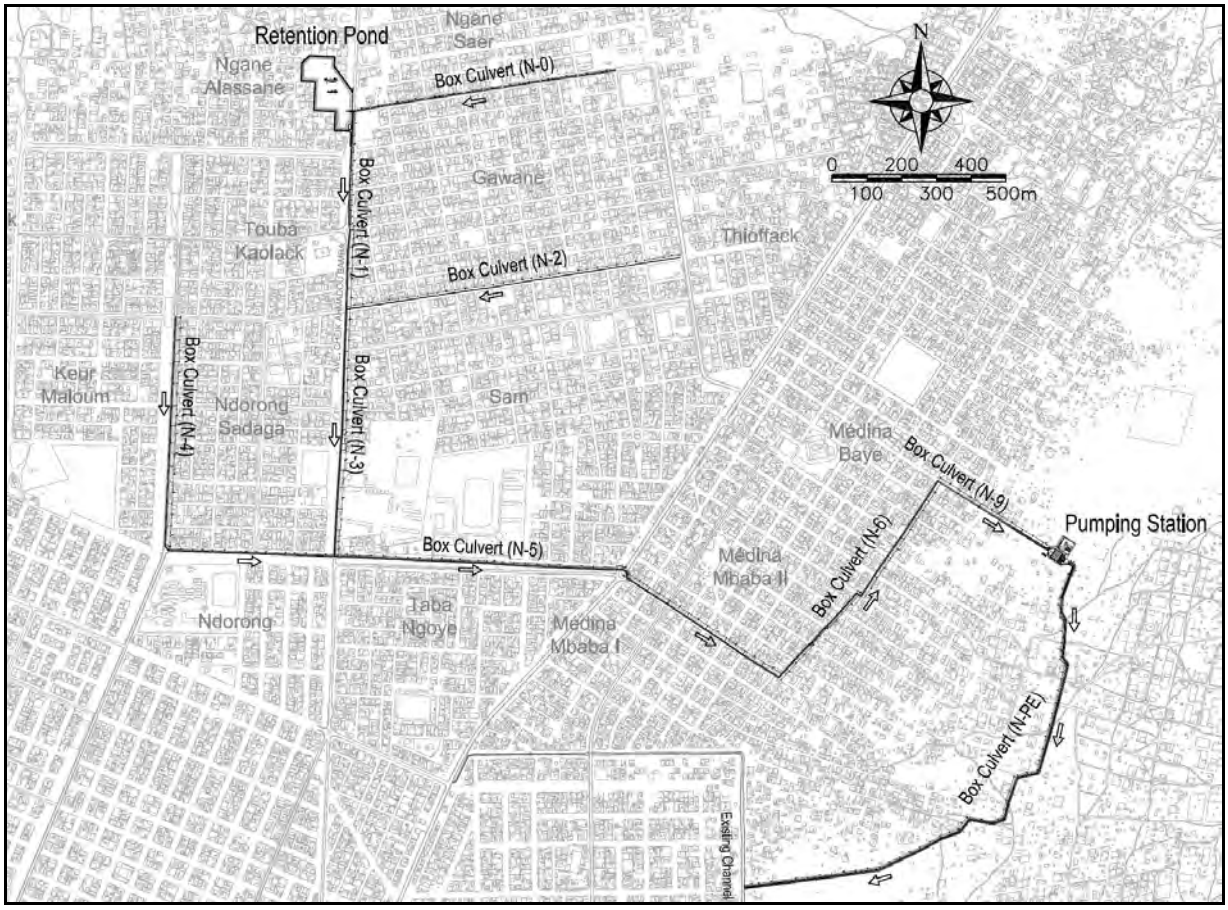


Fig. 4.1.1 Locations of Proposed Drainage Facilities

4.2 Preliminary Design of Drainage Facilities

4.2.1 General

(1) Design Scale

The design scale means safety level under which storm water can be safely conveyed through structural countermeasures, such as drainage network system, pumping station and retention ponds. As described in the proceeding section, 10-years design storm could be adopted for the drainage plan of Kaolack City.

(2) Basic Data Used

Basic topographic map and other data used in the preliminary design are as follows:

(a) Topographic Maps

- The topographic survey was conducted in the Feasibility Study stage.
- Cross-sections (ground level) at major points (50 m interval) and longitudinal profiles (ground elevation) surveyed are used as basis in the design of box culvert.

(b) Soil Conditions

- Soil investigation by boring and soil analysis was conducted in the Feasibility Study stage. Major soil data obtained from the above is utilized in the design of drainage facilities such as drainage box culvert, pumping station and retention pond, and construction method.

(c) References

- The Study on Urban Drainage and Wastewater Systems in Dakar City and its surroundings, JICA, 1994
- Urban Storm and Wastewater Sanitation Master Plan in Kaolack, Sanitation Department, Ministry of Hydraulic, 1982
- Guideline for Planning and Design of Sewerage Facility, Japan Sewage Works Associations, 2009
- The Standard Civil Design Drawings, Ministry of Land Infrastructure Transport and Tourism, Japan.

(3) Hydraulic Analysis

Design discharge for drainage facilities estimated in the Master Plan stage is applied.

4.2.2 Drainage Box Culvert

(1) Basic Line for Construction of New Drainage Box Culverts

The followings are the basic lines for construction of new drainage box culverts.

- Box culvert is constructed by concreting in site in principle.
- Basically, the minimum earth cover of 0.5 m is adopted in accordance with the Standard Civil Design Drawing for box culvert; however, in case that the earth cover is less than 0.5 m, box culvert is analyzed/designed to carry the a combination of loads and forces as required.
- Longitudinal bed slope is set from gentle to steep towards upper end. A minimum velocity value of 0.8 m/s is maintained for the removal of sediments. A maximum velocity of 3.0 m/s shall be adopted, to reduce energy dissipation.
- Direct foundation is applied as the foundation structure of box culvert considering soil and geological condition.
- Manhole is installed at major intersections, points of changing size and pipe junction except for connections to house or building.

(2) Proposed Route and Design Discharge of New Drainage Box Culverts

The proposed route of new drainage box culvert is as shown in **Fig. 4.2.1**, mostly under the road. Total length of new box culvert is about 8,280 m. The estimated design discharge for new drainage box culvert with 10-year return period of design scale is presented in **Fig. 4.2.1**.

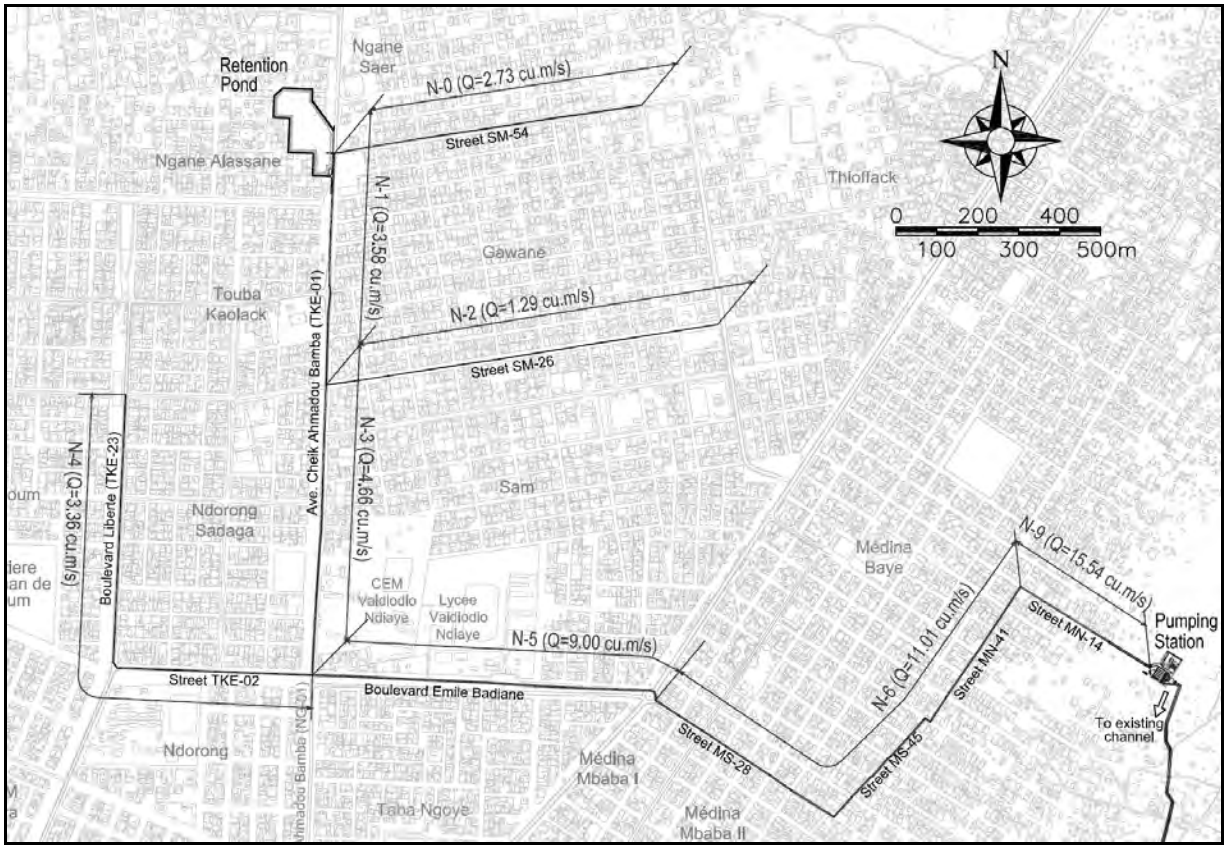


Fig. 4.2.1 Proposed Route and Design Discharge for New Drainage Box Culvert

(3) Preliminary Design of New Drainage Box Culvert

In accordance with the above section of design criteria for drainage facilities, new drainage box culverts were designed.

- The proposed route of new drainage box culvert is tabulated in Table 4.2.1. Total length of new box culverts is about 8,280 m.

Table 4.2.1 Proposed Route of New Drainage Box Culvert

Proposed Box Cuvert	Street Number/Name	Type of Pavement
N-0	Street SM-54	Asphalt
N-1	Ave. Cheik Ahmadou Bamba (TKE-01)	Asphalt
N-2	Street SM-26	No pavement (earth road)
N-3	Ave. Cheik Ahmadou Bamba (TKE-01)	Asphalt
N-4	Boulevard Liberte (TKE-23), Street TKE-02	Concrete
N-5	Boulevard Emile Badiane	Asphalt
N-6	Street MS-28, Street MS-45, Street MN-41	No pavement (earth road)
N-9	Street MN-14	No pavement (earth road)
N-PE	No street number	No pavement (earth road)

- The new drainage line is divided into several sections depending on design discharge.
- In order to operate and maintain the new box culverts smoothly and effectively, manholes are installed. The number of manholes will be 153 locations.
- Major feature of the drainage box culverts are as below:

Table 4.2.2 Major Features of Drainage Box Culverts

Proposed Box Culvert	Size (width × depth)	Length (m)	Number of Manholes
N-0	1.7m × 1.7m	761.5	14
N-1	2.0m × 1.8m	568.2	13
N-2	1.2m × 1.2m	970.5	18
N-3	2.2m × 2.0m	711.1	15
N-4	1.6m × 1.6m	1,151.5	20
N-5	2.5m × 2.4m	859.6	17
N-6	2.7m × 2.6m	1,265.5	22
N-9	2.9m × 2.9m	374.3	6
N-PE	(2.1m × 1.6m) × 3	1,619.5	28
	TOTAL	**8,281.7**	**153**

- In order to drain road surface flow into the box culvert smoothly and effectively, inlet and inlet pipes are newly installed at intersections. Image of inlet and inlet pipe is as below:

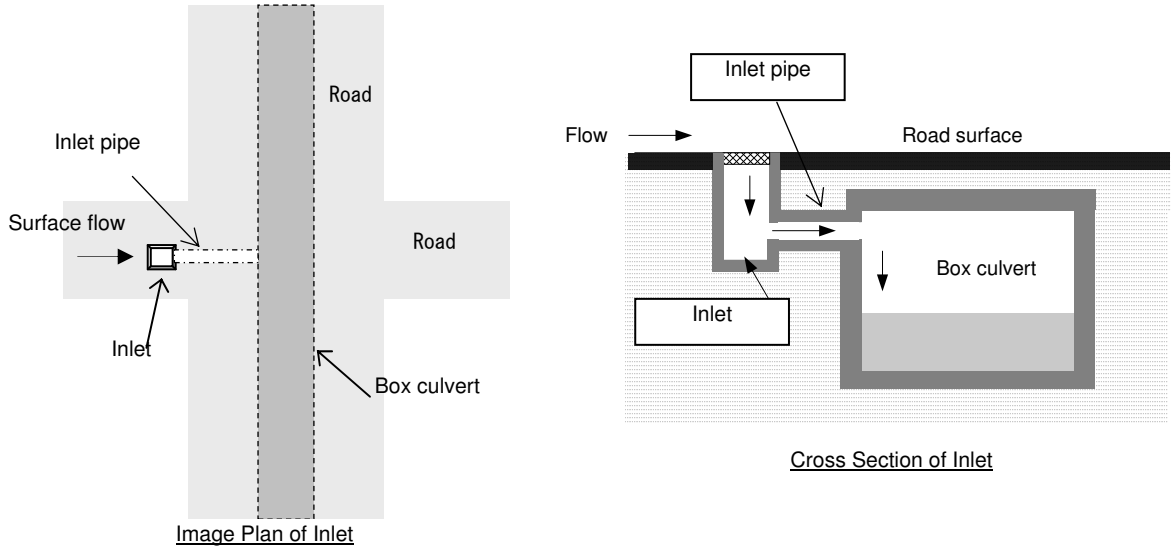


Fig. 4.2.2 Image of Inlet and Inlet Pipe

- Inlet is covered by concrete cover with holes. Details of concrete cover are shown in the "Drawings and Design Notes".
- Regarding construction methodology, the open cut method will be applied at all sites.
- The detailed plans and longitudinal profiles of new drainage box culverts are shown in the "Drawings and Design Notes".

4.2.3 Pumping Station

(1) Basic Conditions for the Construction of New Pumping Stations

The following are the basic conditions for the construction of new drainage pumping stations:

- The pumping station is designed in accordance with "Guideline for Planning and Design of Sewerage Facility, Japan Sewage Works Association, 2009".
- As mentioned in the Master Plan, 10-years design storm is adopted for the design of new pumping stations.

- Economic and design considerations dictate that the pumping station be located in low-lying area.

(2) Proposed Location of New Pumping Station

A pumping station is necessary to remove stormwater from the north area of Kaolack City. The new pumping station will be located at the end point of proposed drainage box culvert lines. Based on the result of discussion with the Kaolack City Hall in consideration of the available area, the location of new pumping station was determined as shown in the **Fig. 4.1.1**. Total required area is about 4,300 m^2. The proposed site is a public land.

(3) Preliminary Design of New Pumping Station

In accordance with the above section, the new pumping station is designed.

- The design discharge for new pumping station estimated in the Master Plan stage is applied. The required total pump capacity is 16.0 m^3/s.
- The number of pumps is set at 5 units and, accordingly, unit capacity of pumps is 3.2 m^3/s, considering operation and maintenance, and available area for pumping station.
- In general, there are 3 types of pumps, namely, i) vertical shaft type, ii) horizontal shaft type, and iii) submergible type. Submergible type is selected for new pumping station in consideration of required pump space, operation, installation works, maintenance and other items. The comparison table is as below:

Table 4.2.3 Comparison of Three Types of Pump

Item	Vertical Shaft		Horizontal Shaft		Submergible	
Required Space	Less area is required.	○	Wider area is required than other types.	△	Less area is required	○
Operation	Priming is not necessary.	○	Priming is necessary, unless positive suction condition. Therefore, automatic operation system needs complicated sequences.	△	Priming is not necessary.	○
Suction Performance	Impeller is located below the suction water level. Cavitation does not occur in most cases.	○	Suction head and rotation speed are limited. Cavitation occurs in more cases than other types.	△	Impeller is located below the suction water level. Cavitation does not occur in most cases.	△
Installation Works	It requires complicated works if the suction pipe length under the floor is long.	△	It requires complicated works if reduction gear and mover are to be coupled to pump after pump is settled.	△	Pump has been assembled with submergible motor before delivery. Installation is only to set down the pump unit.	○
Disassembling for maintenance	Pump is needed to be removed up on the floor for disassembling.	△	Pump can be disassembled without moving from the original position.	○	Pump is needed to be lifted up for disassembling, however, lifting and re-setting works are very simple	○
Maintenance	Pump maintenance situation cannot be checked easily since pump is under the floor.	△	Pump maintenance situation is can be checked easily by sight at anytime.	○	Frequent maintenance is not required. Insulation is to be checked once per month.	○
Noise	Pump noise is smaller than Horizontal shaft type. If engine driven type is applied, anti-noise measure might be necessary.	○	Pump noise is biggest among three types. If engine driven type is applied, noise protection is necessary.	△	Both pump and mover are set in the water, and noise is smallest among three types.	○
Evaluation	○		△		◎	

Legend: ◎ – Best, ○ - Better, △ - Good

The plan of the pumping station is shown in **Fig. 4.2.3**.

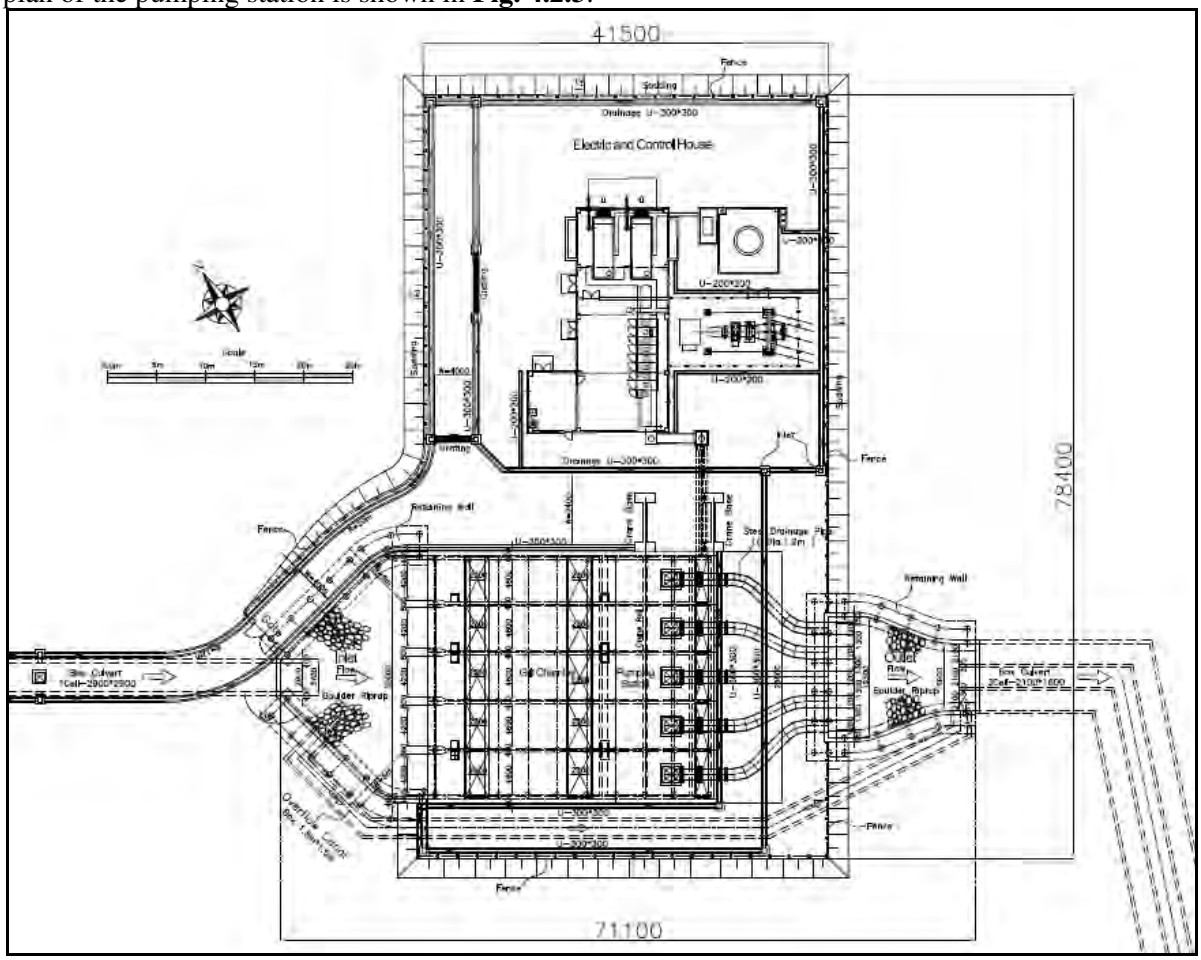


Fig. 4.2.3 Plan of New Pumping Station

- Pump Well: 5.0 m (length) × 4.2 m (width) × 3.7 m (depth) × 5 (units)
- Grit Chamber: 11.4 m (length) × 4.2 m (width) × 3.2 m (depth) × 5 (units)
- Discharge Pipe: 1,200 mm (diameter) × 5 (units) × 16 m to 18 m (length)
- Pump Total Head: 3.26 m
- Foundation for grit chamber and pump well: Steel Pipe Pile Foundation (Dia. 600 mm × Length 17 to 20 m)
- Two diesel generators (750 kVA) will be provided as emergency power source.
- An overflow box culvert shall be provided for use in the event the pumping station must be shut down or the pumping station does not function.
- Detailed plans and sections of the pumping station are shown in the "Drawings and Design Notes".

4.2.4 Retention Pond

The retention pond, which has the function of temporarily storing runoff discharge and flattering the peak runoff discharge, is proposed as the flood mitigation facilities.

(1) Basic Conditions for the Design of Retention Pond

The following are the basic conditions for the design of retention pond.

- Facilities are designed hydraulically to ensure fulfillment of their flood control functions.
- The retention pond is designed in accordance with "Technical Standards for Planning and Design of Stormwater Retention Pond (Draft), Japan Sewage Works Associations".

- In consideration of topographic feature and present site condition, the excavated pond will be applied for type of retention pond.

(2) Proposed Location of the Retention Pond

The proposed location of the retention pond will be as shown in **Fig. 4.1.1**. The proposed location is a low lying area, therefore, during the raining, spontaneously, rainwater will be drained to proposed site through road surface. There are public and private lands in the proposed site. Owners of private land are shown in **Table 4.5.2** of **APPENDIX Environmental and Social Consideration**.

(3) Preliminary Design of Retention Pond

In accordance with the above section of design criteria, the retention pond was designed.

- General plan of the retention pond is shown in following Fig. 4.2.4.

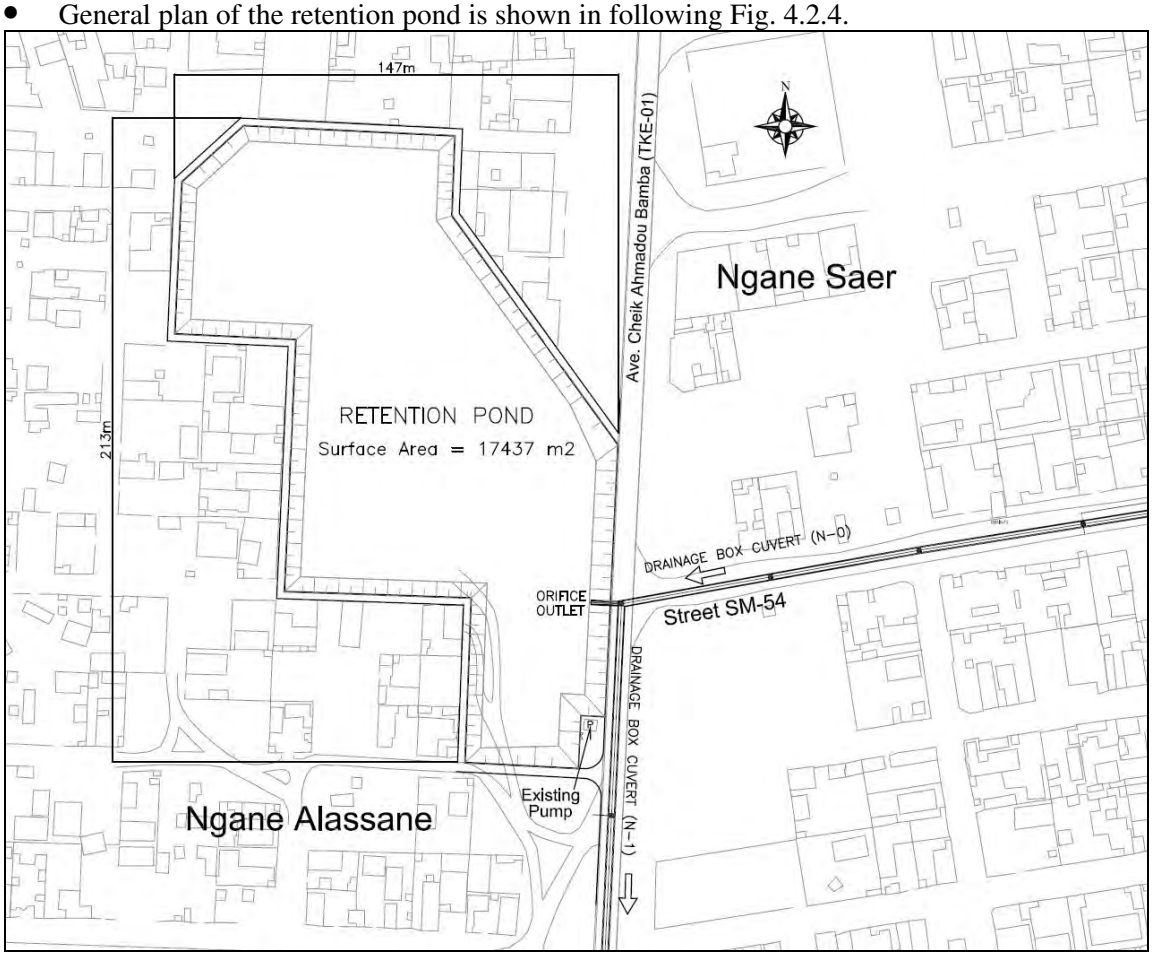


Fig. 4.2.4 General Plan of the Retention Pond

- Major features of the retention pond are as below:

Table 4.2.4 Major Features of the Retention Pond

Surface Area (m^2)	Bottom Surface Area (m^2)	Bottom Elevation (EL.m)	Gross Storage Capacity (m^3)	Maintenance Road Elevation (EL. m)
17,437[4]	14,250	0.85	39,000	3.35

[4] In the Master Plan, surface area of retention pond was roughly estimated at 15,000 m^2.

- Minimum freeboard of the retention pond against maximum water level in the facility is set at 0.6 m.
- 2.5 m of berms width is adopted considering proper construction procedure. Berms will be covered with concrete pavement.
- Side of slope of excavation is designed at more than 1.0 vertical to 2.0 horizontal to secure the stability of slope.
- The retention pond is surrounded by a grid wire fence for security.
- Vegetation provides erosion control and enhances site stability. Side-sloping areas will be planted with native grasses.
- Typical cross section of the retention pond is shown in the following figure.

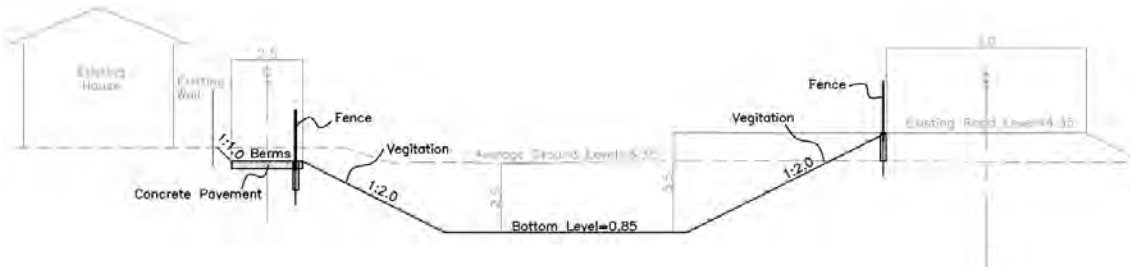


Fig. 4.2.5 Typical Cross Section of the Retention Pond

- The retention pond has an orifice outlet of 1.0 m × 1.0 m at downstream end. Discharge volume is calculated by the following formula:

$H \le 1.2D \quad Q = 1.75 \times B \times H^{3/2}$

$H \ge 1.8D \quad Q = C \times B \times D \times \sqrt{2g(H - D/2)}$

In case of 1.2D < H <1.8D, discharge volume Q is a linear approximation using the Q of the two equations above.

Where,

Q = discharge volume, m^3/sec
C = coefficient of discharge (=0.6)
B, D= B: width, D: depth, m
H = effective head on the orifice, from the center of orifice to the water surface, m
g = acceleration of gravity, m^2/sec

- The cross section of orifice outlet is shown in the following figure.

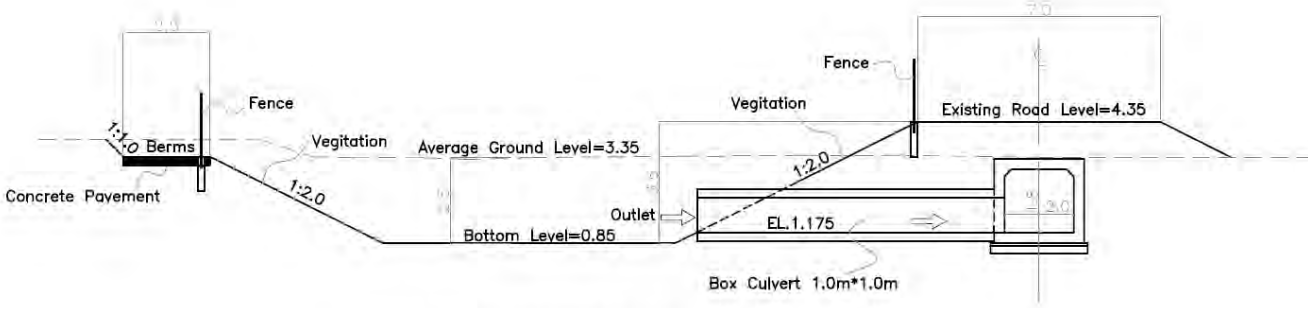


Fig. 4.2.6 Cross Section of Orifice Outlet

- Detailed plans and sections of the retention pond are shown in "Drawings and Design Notes".

4.3 Construction Plan

(1) General Circumstances

To consider the construction plan for drainage facilities, it is necessary to study the general circumstances relating to the availability of the construction materials. The remarkable points on the procurement of construction materials are as follows.

- Available steel materials are very limited so that the temporary use of steel materials for the earth work and/or structural work is not a common method in Senegal.
- Mechanical items such as pumping equipment need to be imported from foreign countries.
- There is no commercial batching plant for both ready mixed concrete and asphalt. Only major contractors in Dakar have their own batching plants.

(2) Construction Plan

Based on the general circumstances in Senegal, the followings are considered for the condition of construction for drainage facilities, i.e. drainage box culvert, pumping station, and retention pond.

- Open-cut excavation shall be applied.
- During the excavation below the underground water, it is necessary to lower the water table by using submersible water pumps.
- As shown in the following typical cross section of excavation for box culvert, 1.0 m width beside box culvert is considered as working space. For the purpose of slope stability, 1m width of temporary berm and 1:1 slope above the berm is assumed.

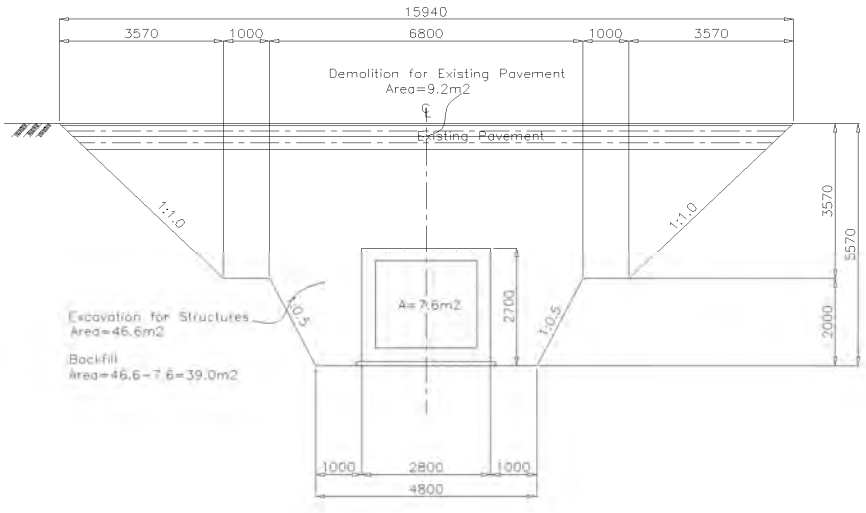


Fig. 4.3.1 Typical Cross Section of Excavation for Box Culvert

- On-site batching plant for both concrete and asphalt shall be set up.
- Where enough width for the road cannot be kept due to open excavation, the existing road shall be used as temporary diversion road to keep the traffic.
- Judging from the width of open cut excavation for box culvert and huge quantity of its excavated soil, there is no space to stockpile the excavated material beside excavated area so that it will be necessary to carry the soil to the disposal yard (15 km away from the site). Therefore, the use of soil imported from the borrow pit is assumed for the backfilling.
- Location of disposal yard for both excess excavated soil and concrete debris is about 15 km away from the central of Kaolack.
- Location of borrow pit for imported soil is about 20 km away from the center of Kaolack
- Judging from boring data, it is assumed that the soil condition downstream of proposed pumping station is soft. Therefore, the ground improvement works underneath the proposed Box Culvert N-PE (L=1,619.5 m) will use the soil replacement method (use of imported sand) is considered.

(3) Major Construction Machinery

Major construction machineries to be used in the Project are as follows.

Table 4.3.1 Major Construction Machinery

Works	Construction machineries
Earth Works	・ Excavators 0.7 to 1.2 m^3 ・ Dump Trucks 10 ton ・ Bulldozers 3 to16 ton ・ Compacting Rollers 1 ton ・ Tamping Rammer
Piling Works	・ Piling Rigs ・ Truck (or rough terrain) cranes 20 to 50 ton
Concrete Works	・ Truck (or rough terrain) cranes 20 to 25 ton ・ Concrete Pump Trucks ・ Concrete Hoppers (base machine 20 to 25 ton crane)1 m^3
Road Works	・ Giant Breakers ・ Bulldozers 12 to 16 ton ・ Wheel Loader 1 m^3 ・ Motor Graders ・ Macadam Rollers 10 ton ・ Tire Rollers 20 ton ・ Asphalt Pavers ・ Concrete Pavers
Mechanical Works	・ Truck (or rough terrain) cranes 20 to 25 ton ・ Crawler Cranes 100 ton

4.4 Cost Estimate

4.4.1 Construction and Engineering Costs

(1) Construction Cost

Construction Cost is calculated based on the various cost information obtained from ONAS Dakar, ONAS Kaolack, local firms and Japanese firms. The followings are the general conditions for the construction cost estimate.

- Construction cost is estimated at 2013 price level.
- Annual price escalation rate of 3% is applied when using cost data of past project.
- All necessary costs other than direct construction cost, i.e. the cost for common temporary works such as preparation of temporary site office, access road, and also site expenses, contractor's overhead, a profit, are included in construction cost.

- The cost is classified into foreign and local currency portions based on information on procurement obtained in Senegal.
- Construction methods are as stated in **Section 4.3** of the construction plan.

(2) Engineering Cost

- Engineering cost is the cost for consultancy services, i.e. the detailed design, pre-construction phase services including tender and construction supervision, etc. Engineering cost is calculated based on the cost information obtained from the local firms.
- Engineering cost is estimated at 2013 price level.
- The cost is classified into foreign and local currency portions assuming that both foreign and local consulting firms are jointly involve in the proposed project.
- The following durations are assumed for the consulting services.
  - Detailed design, pre-construction phase services 18 months
  - Construction supervision 36 months
- Price escalation (FC 2.0%, LC 3.0%) is included.
- Physical contingency (10%) is included.

4.4.2 Project Cost

(1) Element of Project Cost

Element of project cost is as follows.

- Construction Cost [Refer to Sub-section 4.4.1 (1)]
- Price Escalation: Annual Rate FC: 2% , LC: 3% for construction cost
- Physical Contingency: 10 % of construction cost
- Engineering Cost [Refer to Sub-section 4.4.1 (2)]
- Land Acquisition Cost (acquisition cost of vacant land for new construction of facilities): 15,000 FCFA/m^2 for pumping station and 12,500 FCFA for retention pond, inclusive of the price escalation and physical contingency that is the same percentage of construction cost and engineering cost
- Project Administration Cost: 2% of total amount for construction cost, engineering cost and land acquisition cost
- VAT: 18%
- Import Tax: 9%
- Interest Rate during Construction Project: Annual Rate 1.4 % for construction cost, 0.01 % for engineering cost
- Front-end Fee; 0.2 % of total amount for construction cost, engineering cost and interest during construction

Above-mentioned percentages for each element are set up based on the following points:

- Price escalation during the project from 2015 and 2020 is assumed based on the past 10 year data on the inflation rate by the World Bank.
- Percentage of both physical contingency and project administration cost is assumed judging from the data obtained from the past project in Senegal or other countries.
- Planned materials to be imported are steel materials such as steel piles, ductile iron pipes, sheet piles, etc. and mechanical equipment. Import tax of 9% for those materials is assumed based on the information from local and Japanese firms.
- Land acquisition cost is based on the information from the Ministry of Economy and Finance.
- Interest rate during construction project is calculated based on the duration of project (2015 to 2020). The assumed percentage is based on the condition of Yen loan. The percentage for

interest rate during construction project is determined by GNI (Gross National Income) per capita. In case of Senegal, since GNI per capita is between USD1,026 and USD1,945, the percentage for low income country is applied.

(2) Project Cost Estimates

Project Cost is estimated based on the abovementioned elements. The total project cost amounts to approximately 37,640 million FCFA at 2013 price level, of which 31,480 million FCFA is local currency portion and 6,160 million FCFA is foreign currency portion.

Table 4.4.1 Project Cost

Cost Item	Work Item	L/C (million FCFA)	F/C (million FCFA)	Total (million FCFA)
Construction Cost	Box Culvert	15,295	0	15,295
	Pumping Station	1,621	3,120	4,741
	Retention Pond	426	0	426
	Total	17,342	3,120	20,462
Price Escalation		2,937	298	3,235
Physical Contingency		2,028	342	2,370
Engineering Service		2,479	1,301	3,780
Land Acquisition		379	0	379
Government Administration		604	0	604
VAT		5,372	0	5,372
Import Tax		339	0	339
Interest during Construction		0	1,037	1,037
Front-end Fee		0	62	62
Total (million FCFA)		31,480	6,160	37,640

4.4.3 O&M Cost

Aside from the above, annual operation and maintenance cost of drainage facilities are estimated as follows and the details are explained in Chapter 5 of Master Plan. Annual cost for operation and maintenance activities is 19.1 mil FCFA.

Table 4.4.2 Annual O&M Cost

Facilities	Cost (mil FCFA)	Remark
Box Culvert	2.9	Cleaning work: 4 km length in a year
Pumping Station	10.5	Including electric fee, personal expense and miscellaneous expense
Retention Pond	5.7	Cleaning work: one time in a year
TOTAL	**19.1**	

4.5 Economic and Financial Analysis

4.5.1 Economic Analysis on Priority Project

(1) Methodology

Preconditions of the analysis for the priority project are the same as those of the Master Plan. (Refer to **Subsection 5.9.1 Methodology** of the Master Plan for the details of the methodology.)

(2) Cost-Benefit Analysis

(a) Project Cost

The following items are included in the cost calculation:

- Construction Works
- Physical Contingency
- Consulting Services
- Land Acquisition

- Administration Cost
- Operation and Maintenance Cost

The land used for the facilities was finally identified that it is private one, and there is some possibility that it will be used for economic activities. Thus, the land acquisition cost is included. These cost items are converted to economic ones. Calculation results are shown in **Tables 4.5.3**.

(b) Project Benefit

The benefit of the drainage component is to reduce the down time of economic activities due to inundation. Economic down time is estimated by the estimated inundation depth. It is assumed that the severest inundation (70 cm) lasts about 1 to 2 weeks and others last pro rata. This down time is converted to an economic value with per capita GDP projection. Finally, the total benefit is calculated including multiplier effect. Details of the benefit calculation are explained in **5.9.2 Cost Benefit Analysis** of the Master Plan part.

Table 4.5.1 Estimated Inundation Depth and Duration

Drainage Area	District Name	Affected Population (persons)		Estimated Inundation Depth (median, cm)		Estimated Duration (median, Days)	
		2012	2030	2012	2030	2012	2030
Khakhoune	Ngane Alassane	92	847	30	45	4.29	6.43
	Ngane Saer	40	298	30	45	4.29	6.43
	Gawane	85	404	30	45	4.29	6.43
	Touba Kaolack	483	1,553	30	45	4.29	6.43
	Ndorong Sadaga	600	2,115	30	45	4.29	6.43
	Ndorong	216	1,025	30	45	4.29	6.43
Ngane Saer	Ngane Saer	161	675	20	30	2.86	4.29
Sam	Gawane	411	1,592	25	30	3.57	4.29
	Sam	270	720	25	30	3.57	4.29
Tobangoye	Tabangoye	516	984	15	20	2.14	2.86
	Médina Mbaba I	106	503	15	20	2.14	2.86
TOTAL		2,981	10,715	—	—	40.02	57.17

Table 4.5.2 Value of Down Time in Economic Activities

	2012	2015	2020	2025	2030
Total Affected Population	2,981	4,270	6,419	8,567	10,715
Per Capita GDP Projection (US$)	1,166	1,204	1,267	1,330	1,394
Total Down Duration (days × persons)	10,726	16,318	27,801	40,859	57,171
Total Time Value (US$)	34,253	53,813	95,509	148,934	218,325
Total Time Value with Multiplier Effect (US$)	369,620	580,691	1,041,428	1,607,151	2,355,943
Total Time Value with Multiplier Effect (million FCFA)	191	300	539	831	1,219

Source: JICA Expert Team and World Bank

Multiplier Effect

An increase in GDP triggers an additional increase in GDP. According to a macro economic theory, GDP consists of consumption and saving, and an increase in the consumption as the result of increase in GDP causes increase in GDP finally by a factor of 10.75. This means that the total benefit is increased by 10.75 times. Details are explained in **Subsection 5.9.2 Cost-Benefit Analysis** of the Master Plan.

(c) Calculation Result

EIRR is calculated at 3.1%. Although this figure is less than 12.0% of Social Discount Rate, the project seems reasonable, considering that it is an infrastructure development. Detailed calculation is shown in **Table 4.5.3**.

The reason why the EIRR of the Priority Project is lower than that of the Master Plan (6.7%) is that the former focuses on such areas where the population density is high in 2012 but it is assumed to stop increasing in later years and excludes such areas where the population density is low in 2012 but it is getting higher in later years. These areas are covered in the later project phase of the Master Plan.

Table 4.5.3 EIRR Calculation

Unit: Million FCFA

Year	Cost							Benefit	Net Benefit
	Construction Works	Physical Contingency	Consutling Services	Land Acquisition	Administration	O&M	Total		
2014	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	158.0	0	2.5	0.0	160.5	0.0	-160.5
2016	0.0	0.0	1,363.4	189	29.4	0.0	1,581.8	0.0	-1,581.8
2017	4,598.8	512.2	516.1	129.36	120.1	0.0	5,876.5	0.0	-5,876.5
2018	7,116.1	815.2	645.3	0	184.0	4.1	8,764.7	114.4	-8,650.2
2019	4,515.8	539.3	528.5	0	128.5	10.6	5,722.7	318.0	-5,404.7
2020	1,456.6	178.9	172.1	0	42.8	14.6	1,865.0	494.3	-1,370.7
2021						16.0	16.0	593.5	577.6
2022						16.0	16.0	649.7	633.8
2023						16.0	16.0	717.9	701.9
2024						16.0	16.0	779.7	763.7
2025						16.0	16.0	831.3	815.3
2026						16.0	16.0	897.5	881.5
2027						16.0	16.0	978.1	962.2
2028						16.0	16.0	1,050.3	1,034.3
2029						16.0	16.0	1,127.1	1,111.2
2030						16.0	16.0	1,218.6	1,202.6
2031						16.0	16.0	1,218.6	1,202.6
2032						16.0	16.0	1,218.6	1,202.6
2033						16.0	16.0	1,218.6	1,202.6
2034						16.0	16.0	1,218.6	1,202.6
2035						16.0	16.0	1,218.6	1,202.6
2036						16.0	16.0	1,218.6	1,202.6
2037						16.0	16.0	1,218.6	1,202.6
2038						16.0	16.0	1,218.6	1,202.6
2039						16.0	16.0	1,218.6	1,202.6
2040						16.0	16.0	1,218.6	1,202.6
2041						16.0	16.0	1,218.6	1,202.6
2042						16.0	16.0	1,218.6	1,202.6
2043						16.0	16.0	1,218.6	1,202.6
2044						16.0	16.0	1,218.6	1,202.6
2045						16.0	16.0	1,218.6	1,202.6
2046						16.0	16.0	1,218.6	1,202.6
2047						16.0	16.0	1,218.6	1,202.6
2048						16.0	16.0	1,218.6	1,202.6
2049						16.0	16.0	1,218.6	1,202.6
2050						16.0	16.0	1,218.6	1,202.6
2051						16.0	16.0	1,218.6	1,202.6
2052						16.0	16.0	1,218.6	1,202.6
2053						16.0	16.0	1,218.6	1,202.6
2054						16.0	16.0	1,218.6	1,202.6
2055						16.0	16.0	1,218.6	1,202.6
2056						16.0	16.0	1,218.6	1,202.6
2057						16.0	16.0	1,218.6	1,202.6
2058						16.0	16.0	1,218.6	1,202.6
2059						16.0	16.0	1,218.6	1,202.6
2060						16.0	16.0	1,218.6	1,202.6
Total	17,687.3	2,045.5	3,383.4	318.4	507.4				
								EIRR	3.1%

4.5.2 Financial Analysis on Priority Project

Solution or mitigation of stormwater drainage is one of the tasks of the municipal or national government which should be implemented as infrastructure development. Thus, all the cost should be managed by governmental budget and it is inappropriate to collect charges from the residents. It means that it is inappropriate to calculate the benefit for the purpose of financial analysis. Details are explained in **Sub-section 5.10.2, Cost-Benefit Analysis**, of the Master Plan.

(1) Review on Kaolack City Budget

As discussed in **Subsection 2.6.2** of the Master Plan, the city's budget is eventually controlled by the central government, or the Ministry of Economy and Finance (MEF). The budget is not all expended. Hence, some amounts remains in a fiscal year and some are carried over to the next fiscal year. The reason why there are remaining amounts is that usually the budget is allocated by the MEF in the account of the city government after several months have passed from the beginning of a fiscal year. The remaining budget is thus used as operating funds which include salaries and some other necessary payments at the beginning of the next fiscal year.

The budget for the drainage canal cleaning is shown below.

Table 4.5.4 Budget for Drainage Canal Cleaning of Kaolack City

Year	Final Forecast	Realization	%
2005	19,122,950	19,080,000	99.78
2006	14,659,280	14,640,000	99.87
2007	10,000,000	0	0.00
2008	19,999,976	19,998,564	99.99
2009	10,000,000	9,917,699	99.18
2010	10,000,000	5,031,048	50.31
2011	15,000,000	4,548,192	30.32
2012	23,000,000	7,085,000	30.80

Source: Ministry of Economic and Finance and Kaolack City

The realization percentage has been low since 2010 because the tax revenue has been low because of the economic recession. If the Senegal's economy gets well, the budget will be secured at around ten million FCFA and it is absolutely short to fully maintain the drainage canals. Even in 2012, however, the realization rate is still low, less than one-third. Thus, support or subsidies from the national government is essential for the development of the drainage system.

The whole budget of Kaolack City is presented in **Table 4.5.5**. The realized revenue is less than 2,000 million FCFA.

(2) Simplified Cost Simulation

Simplified cost simulation was conducted in order to investigate future costs through the project implementation and operation and maintenance taking into consideration the loan cost (principal repayment and interest payment) from the viewpoint of the project implementation agency, Kaolack City.

[Assumptions for the Simulation]

1. Costs for eligible items (Construction Works, Price Escalation, Physical Contingency, and Consulting Services) are financed by loan.
2. Costs for eligible items (Cash Outflow) are just offset by loan disbursement for them (Cash Inflow). Therefore, these two cash flows are cancelled and do not appear in the simulation.
3. Loan conditions are as follows: Maturity: 30 years; Grace Period: 10 years, Interest Rate: 1.4% for Construction Works; Price Escalation and Physical Contingency; and 0.01% for Consulting Services.
4. Simulation period is from 2014 to 2050 when all the principal repayment is finished.
5. Costs for non-eligible items (Land Acquisition, Administration, VAT, Import Tax, Loan Cost,

and Operation and Maintenance) are financed by Kaolack City's own fund or a subsidy by the Government.

6. Other taxes and charges levied are not considered.

The simulation result is shown in **Table 4.5.6**. Yearly cost peaks at 1,826 million FCFA for 2031 in the period after the construction is completed. The maximum amount is 2,668 million FCFA for 2018 mainly due to VAT payment. Principal repayment exceeds 1,000 million FCFA for 19 years from 2030 to 2048.

Table 4.5.5 Budget of Kaolack City

Unit: FCFA

Item	2009			2010			2011			2012		
	Forecast	Realization	%	Forecast	Realization	%	Forecast	Realization	%	Forecast	Realization	%
Revenue												
Ordinary Revenue												
Treasury advance	-	-		-	125,000,000	-	-	-	-	-	-	-
Carryover	132,693,685	134,322,219	101.2	-	85,810,602	-	124,311,330	124,311,330	100.0	117,132,765	168,127,064	143.5
Operating Revenue	146,251,792	91,061,203	62.3	286,947,408	70,994,643	24.7	277,982,894	68,063,147	24.5	231,002,536	81,609,501	35.3
Land Use Tax	596,253,827	485,546,650	81.4	614,539,750	492,690,100	80.2	608,718,100	510,352,270	83.8	604,490,630	453,665,200	75.0
Local Tax	637,612,638	504,796,740	79.2	722,556,280	522,676,543	72.3	636,324,143	598,420,198	94.0	616,692,755	535,380,200	86.8
Municipality Tax	203,022,076	105,185,905	51.8	292,609,329	139,849,039	47.8	184,969,285	122,729,323	66.4	180,799,851	217,156,517	120.1
Misclaneous Revenue	75,585,352	31,506,524	41.7	50,121,276	33,257,173	66.4	39,013,231	39,076,985	100.2	43,234,224	35,639,745	82.4
Allocation fund	125,970,551	101,714,000	80.7	-	104,000,000	-	94,359,750	94,359,750	100.0	93,000,000	93,000,000	100.0
Refunding of Contribution	231,273,684	175,884,975	76.1	254,312,723	154,306,862	60.7	179,681,017	116,403,332	64.8	119,667,908	9,002,112	7.5
Ordinary Revenue Total	2,148,663,605	1,630,018,216	75.9	2,221,086,766	1,728,584,962	77.8	2,145,359,750	1,673,716,335	78.0	2,006,020,669	1,593,580,348	79.4
Investment Revenue												
Carryover	208,667,663	50,232,989	24.1	271,686,634	91,751,767	33.8	228,322,385	19,115,576	8.4	15,000,000	15,000,000	100.0
Subsidy	-	14,000,000	-	-	42,000,000	-	7,000,000	7,000,000	100.0	158,322,985	54,343,680	34.3
Carryover of subsidy	257,860,014		0.0	-	45,824,480	-	87,824,480	87,824,480	100.0	19,103,292	19,103,292	100.0
Investmet Revenue Total	466,527,677	64,232,989	13.8	271,686,634	179,576,247	66.1	323,146,865	113,940,056	35.3	192,426,277	88,446,972	46.0
Revenue Total	2,615,191,282	1,694,251,205	64.8	2,492,773,400	1,908,161,209	76.5	2,468,506,615	1,787,656,391	72.4	2,198,446,946	1,682,027,320	76.5
Expenditure												
Ordinary Expenditure												
Insurance and Allowance	5,000,000	0	0.0	6,100,000	0	0.0	3,100,000	560,210	18.1	3,223,796	0	0.0
Contribution	67,000,000	32,638,650	48.7	368,802,514	73,000,000	19.8	109,862,762	90,500,000	82.4	24,862,762	0	0.0
Mayor's office	219,275,907	147,057,771	67.1	194,715,660	191,120,739	98.2	202,842,690	142,322,950	70.2	165,758,360	149,019,350	89.9
General Administraion	276,170,410	246,799,666	89.4	244,750,340	230,949,397	94.4	292,662,083	250,767,539	85.7	251,639,179	211,798,295	84.2
Municipal accounting	27,260,506	21,458,245	78.7	58,601,008	28,250,937	48.2	33,012,682	29,713,389	90.0	34,018,943	28,727,937	84.4
Municiapl tax office	178,261,091	165,326,606	92.7	183,044,945	165,171,415	90.2	177,440,822	149,700,649	84.4	168,984,566	161,674,477	95.7
Slauterhouse, market	788,000	120,000	15.2	2,288,000	620,000	27.1	3,588,000	1,620,000	45.2	2,970,800	2,884,740	97.1
Building maintenance	26,195,449	19,119,445	73.0	33,369,438	25,154,422	75.4	82,631,196	68,441,867	82.8	84,771,778	65,614,651	77.4
Protection of pople	278,542,954	205,369,445	73.7	187,598,883	167,003,389	89.0	167,599,055	137,002,257	81.7	115,998,467	26,765,572	23.1
Road, square, garden	17,547,089	15,285,538	87.1	56,858,654	53,881,559	94.8	63,393,173	45,236,698	71.4	80,078,528	70,400,788	87.9
Garbage collection	108,198,560	100,306,810	92.7	81,548,323	76,629,877	94.0	152,226,600	98,014,218	64.4	137,544,189	117,486,994	85.4
Workshop and garage	86,846,042	68,297,529	78.6	82,001,105	74,351,395	90.7	83,315,277	64,180,062	77.0	81,935,203	66,338,749	81.0
Water service for city facilities	43,145,615	0	0.0	39,075,455	7,231,849	18.5	15,000,000	0	0.0	25,843,301	0	0.0
Sanitary service for city facilities	2,005,795	1,848,650	92.2	1,896,572	1,959,459	103.3	12,746,920	1,985,854	15.6	19,204,390	10,656,820	55.5
Public light	72,653,704	23,380,650	32.2	106,792,263	29,812,458	27.9	46,938,045	12,122,122	25.8	84,668,588	31,474,299	37.2
Education, youth, sport	140,110,497	105,763,237	75.5	45,409,055	43,478,809	95.7	105,015,706	88,765,893	84.5	98,846,815	64,959,448	65.7
Health, hygene	305,985,685	183,459,356	60.0	113,787,354	128,378,473	112.8	220,256,327	162,463,433	73.8	281,099,214	185,986,403	66.2
Cemetry and funeral ceremony	4,100,000	1,999,875	48.8	6,050,000	3,000,000	49.6	6,100,000	2,950,000	48.4	4,200,000	0	0.0
Refund to national government	-	-	-	-	95,000,000	-	-	-	-	-	-	-
Festival and public ceremonies	18,938,100	5,938,100	31.4	16,000,000	12,879,180	80.5	7,444,000	4,244,000	57.0	11,000,000	2,000,000	18.2
Misclanouse expense	163,684,538	102,873,644	62.8	120,710,563	104,648,507	86.7	131,862,027	105,742,554	80.2	171,048,805	126,589,999	74.0
Financial assets	208,667,663	50,232,989	24.1	271,686,634	91,751,767	33.8	228,322,385	19,115,576	8.4	158,322,985	54,343,680	34.3
Ordinary Expenditure Total	2,250,377,605	1,497,276,206	66.5	2,221,086,766	1,604,273,632	72.2	2,145,359,750	1,475,449,271	68.8	2,006,020,669	1,376,722,202	68.6
Extrordinary Expenditure and Investment												
Equipment of administartion	28,795,192	0	0.0	50,187,417	0	0.0	52,688,000	8,815,446	16.7	39,979,746	22,469,796	56.2
Road repair	120,247,671	37,284,849	31.0	140,105,525	74,937,427	53.5	113,323,416	10,832,192	9.6	90,532,270	32,962,915	36.4
Protaction against disasters	-	-	-	3,000,000	0	0.0	3,500,000	0	0.0	-	-	-
Infrastructure of indusrty, commerce, handicrafts	5,000,000	0	0.0	10,000,000	0	0.0	15,500,000	3,951,938	25.5	16,000,000	0	0.0
Saniary, public hygene activities	12,998,140	9,998,140	76.9	10,123,552	0	0.0	20,310,969	0	0.0	20,310,968	20,310,968	100.0
Education, youth, culture, sport	259,860,014	15,106,928	5.8	11,000,000	0	0.0	73,824,480	71,237,188	96.5	4,603,293	2,478,000	53.8
Land and coast imroivement	14,820,140	0	0.0	14,820,140	14,820,140	100.0	-	-	-	-	-	-
Acquisition of heavy equipment	17,812,320	2,950,000	16.6	21,000,000	0	0.0	44,000,000	0	0.0	21,000,000	0	0.0
General study	6,994,200	0	0.0	11,450,000	1,994,200	17.4	-	-	-	-	-	-
Extrordinary Expenditure and Investment Total	466,527,677	65,339,917	14.0	271,686,634	91,751,767	33.8	323,146,865	94,836,764	29.3	192,426,277	78,221,679	40.7
Expenditure Total	2,716,905,282	1,562,616,123	57.5	2,492,773,400	1,696,025,399	68.0	2,468,506,615	1,570,286,035	63.6	2,198,446,946	1,454,943,881	66.2
Balance	-101,714,000	131,635,082		0	212,135,810		0	217,370,356		0	227,083,439	

Table 4.5.6 Simplified Cost Simulation

(Unit: Million FCFA)

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Project Cost (Non-Eligible for Loan)																			
Land Acquisition	0.00	0.00	225.00	154.00	0.00	0.00	0.00												
Administration Cost	0.00	3.00	35.00	143.00	219.00	153.00	51.00												
VAT	0.00	31.00	270.00	1,260.00	1,975.00	1,379.00	457.00												
Import Tax	0.00	0.00	0.00	134.00	205.00	0.00	0.00												
Project Cost (Non-Eligible) Total	0.00	34.00	530.00	1,691.00	2,399.00	1,532.00	508.00												
Operation and Maintenance	0.00	0.00	0.00	0.00	4.94	12.58	17.44	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Loan Cost																			
Repayment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.65	83.75	433.90	982.45	1,365.35	1,492.35	1,492.35
Interest	0.00	0.02	0.17	90.18	233.54	332.45	365.32	365.32	365.32	365.32	365.32	365.32	365.32	365.31	360.80	349.12	332.50	314.23	295.97
Front-end Fee	0.00	62.00																	
Loan Cost Total	0.00	62.02	0.17	90.18	233.54	332.45	365.32	365.32	365.32	365.32	365.32	365.32	373.97	449.06	794.70	1,331.57	1,697.85	1,806.58	1,788.32
Cost Total	0.00	96.02	530.17	1,781.18	2,637.48	1,877.04	890.75	384.32	384.32	384.32	384.32	384.32	392.97	468.06	813.70	1,350.57	1,716.85	1,825.58	1,807.32

Year	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Project Cost (Non-Eligible for Loan)																		
Land Acquisition																		
Administration Cost																		
VAT																		
Import Tax																		
Project Cost (Non-Eligible) Total																		
Operation and Maintenance	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Loan Cost																		
Repayment	1,492.35	1,492.35	1,492.35	1,492.35	1,492.35	1,492.35	1,492.35	1,492.35	1,492.35	1,492.35	1,492.35	1,492.35	1,492.35	1,483.70	1,408.60	1,058.45	509.90	127.00
Interest	277.70	259.44	241.17	222.90	204.64	186.37	168.11	149.84	131.57	113.31	95.04	76.78	58.51	40.25	21.99	8.23	1.64	0.00
Front-end Fee																		
Loan Cost Total	1,770.05	1,751.79	1,733.52	1,715.25	1,696.99	1,678.72	1,660.46	1,642.19	1,623.92	1,605.66	1,587.39	1,569.13	1,550.86	1,523.95	1,430.59	1,066.68	511.54	127.00
Cost Total	1,789.05	1,770.79	1,752.52	1,734.25	1,715.99	1,697.72	1,679.46	1,661.19	1,642.92	1,624.66	1,606.39	1,588.13	1,569.86	1,542.95	1,449.59	1,085.68	530.54	146.00

4.6 Environmental Impact Assessment Study

4.6.1 Description of the Component

This component essentially consists of:

1) Development of drainage channel network (8.3 km in length)
2) Development of a retention pool (15,000 m^2 in area)
3) Construction of a pumping station

4.6.2 Activities Requiring Environmental and Social Considerations

Main activities requiring environmental and social considerations in the work are as follows.

- Supply of construction materials (sand, cement, iron/steal etc.)
- Dredging, excavation and construction of canals, retention pond and pumping station
- Transportation and disposal of solid wastes from the cleaning basin
- Closure of streets affected by the work

4.6.3 Project Area Outlook and Scopes of Assessment

(1) Retention Pond in Touba Kaolack

The planned retention pond is located at Khakhout in Touba Kaolack District, the right side of trunk road (R4) to Gossas. As the land is depressed and unused, it becomes a natural pond during the rainy season. Touba Kaolack District is located in northern periphery of Kaolack City, which is characterized with low population and lack of socio-economic and cultural facilities. In the proposed site, resettlement will not be required since there are no residence, commercial facilities and informal settlers at present.

(2) Pumping Station in Medina Baye

Pumping station site at Medina Fass 2 in Medina Baye District is located in the northern periphery of the City as well. There is a cultural heritage of mosque in the center of District. The site is located at about 350 m east from the mosque and 300 m from the main road behind the mosque. The area is huge, bare and swampy (tans) lands, and it is difficult to access the site by car in the rainy season. In the proposed site, resettlement will not be required since there are no residence, commercial facilities and informal settlers at present.

4.6.4 Considerations on Natural and Social Environment

Possible adverse impacts on both natural and social environment by the stormwater drainage management during construction and operation phases are summarized in **Table 4.6.1.**

Table 4.6.1 Possible Adverse Impacts by Stormwater Drainage Management

Phase	Impact	Intensity	Extended	Importance
Natural Environment				
Construction	Soil contamination by hydrocarbons and drained oil	Low	Local	Minor
	Soil erosion in the sampling sites			
	Recovery of landfill wastes during excavation and construction			
	Degradation of air quality			
	Degradation or destruction of public infrastructure	Strong		Major
Operation	Pre-winter flushing for channels	Low	Local	Minor
	Rainwater retention (in Touba and East Kaolack)	Strong		Major
	Discharge pressure from the pump station (at the outlet of North Medina)	Low	Local	Minor
Social Environment				
Construction	Inhalation of dust	Low	Local	Minor
	Outbreak of infectious diseases (mainly by contaminated water)			

Phase	Impact	Intensity	Extended	Importance
	Traffic jam and accidents	Strong		Major
	Destruction of public infrastructure			
Operation	Injury or accidents (e.g., falling into open canals)			

Based on the possible adverse impacts by stormwater drainage management, the mitigation and minimizing measures as well as monitoring plans are proposed. The following table summarizes the mitigation and minimizing measures as well as the monitoring plans, focusing on the items of "Intensity is Strong and Importance is Major". All the proposed mitigation/minimizing plans as well as monitoring plans are attached in Appendix.

Table 4.6.2 Mitigation/Minimizing Measures and Monitoring Plan of Stormwater Drainage Management

Phase	Impact	Mitigation/Minimizing Measures	Monitoring Plan
Natural Environment			
Construction	Degradation or destruction of public infrastructure	- To minimize the excavated area on the public road especially in installing sewer pipes. - To utilize temporary material such as sheet piles as far as practicable.	- Observation [Frequency: once every 3 months]
Operation	Rainwater retention (in Touba and East Kaolack)	- To remove sediments in the Box Culvert periodically. - To remove sludge and garbage in the existing open channels (at the discharge point of the pumping station).	- Observation [Frequency: once every 3 months]
Social Environment			
Construction	Induction of traffic jam and accidents	- To remove and transport the excavated soil as fast as possible. - To establish diversion road, traffic signs, boards and warning lights at the construction site.	- Observation of traffic volume and traffic jam [Frequency: once every 3 months]
	Destruction of public infrastructure	- To minimize the excavated area on the public road especially in installing sewer pipes. - To utilize temporary material such as sheet piles as far as practicable.	- Observation [Frequency: once every 3 months]
Operation	Injury or accidents	- To maintain the fence constructed on the boundary of the retention pond	- Observation [Frequency: when required]

4.6.5 Alternatives "With Project" (Analysis of the EIA report)

(1) Stormwater Management

(a) Drainage System

The EIA report compares three alternatives and select the proposed drainage system in the Feasibility Study (drainage channel and one retention pond and one pumping station) as the most favorable one, considering cost effectiveness as shown in **Table 4.6.3**.

Table 4.6.3 Comparison of Stormwater Drainage System

Method	Drainage channel (km)	Retention pond (location)	Pumping (location)	Cost
Proposed system in Feasibility Study	8.3	1	1	Lowest
Alternative 1	8.3	0	1	2nd highest
Alternative 2	8.3	0	2	Highest

(b) Drainage Canals

Open and closed channels are evaluated in the EIA report and the closed channel (Box culvert) is selected as the most suitable drainage channel, as shown in **Table 4.6.4**.

Table 4.6.4 Comparison of Stormwater Drainage Channel

Method	Evaluation
Drainage channel proposed in Feasibility Study (Closed Canal)	Closed canals are less visible after construction, and there is no impact on the landscape. There is no risk to inhabitants by solid wastes dumped into the canal.
Alternative 1 (Open Canals)	Construction cost is not high and maintenance is easy. However, there are risks that open canals are used for dumping solid wastes, resulting in deterioration of sanitary condition in the Project site. Good IEC (Information-Education-Communication) of cleaning canals is required.

4.6.6 Environmental Management and Monitoring

Environmental management and monitoring plan with mitigation measures are attached in "Appendix".

4.6.7 Roles of Implementing Agencies and Legal Framework

Roles of implementation agencies and legal framework are described in "Appendix".

4.7 Implementation Program

4.7.1 General

The Implementation Program is formulated in consideration of feasible constructions procedure to complete all the construction works by the target year 2020 and the subsequent cost estimate. The implementation program for the proposed project is based on the following:

- Assumed commencement month of project is November 2014.
- Project needs to be completed by the target year of 2020.

4.7.2 Basic Condition

Loan project for drainage facilities is assumed to consider the implementation program. The following assumed duration before the construction project is based on the information from WB, AfDB, IDB, etc.

- Fund arrangement (E/N, L/A) and procurement of Consultant: 12 months
- Detailed Design, Tender and the contract of the Contractor: 18 months

To decide the duration for the construction project, the standard productivity published by the Ministry of Land, Infrastructure, Transport and Tourism in Japan and also the JICA cost estimate manual is referred.

4.7.3 Implementation Plan

To study the implementation plan for drainage facilities, the following points shall be taken into account.

- As stated in **Sub-section 2.1.4** of the Master Plan, annual rainfall in Kaolack that mainly occurs between July to September is about 560 mm. During the rainy season, monthly rainfall is about 120 mm to 220 mm. From the said data, compared to Japan or Southeast Asian Countries, rainfall amount is much less. In our proposed project, major civil works for drainage facilities are concrete works and earth works. Therefore, it is expected that the rainfall during the rainy season for three months will cause the deterioration of productivity. In addition, there are a lot of public holidays (14 days/year) in Senegal. However, in general, there are no special conditions which tremendously affect productivity. In conclusion, work stop coefficient, 1.35, which is applied for normal condition, is used based on the JICA cost estimate manual. Besides, regional coefficient for labor and equipment, that is 2.0 for simple labor works, 3.5 for skilled labor works and 70% for the works by machineries in a region of Africa, is applied.
- In principle, the works for drainage box culvert shall be carried out from downstream to upstream.
- The works for box culverts, pumping station and retention pond shall be commenced concurrently so that it will be possible to complete the overall works within 36 months.

- Judging from work volume and sequence, construction works of drainage box culverts of about 8.3 km is apparently the critical path. The followings are the working sequence for the construction of box culvert:

1) Demolition of existing asphalt road
2) Excavation
3) Lean concrete
4) Rebar, formwork for base
5) Casting base concrete
6) Rebar, formwork, scaffolding for wall
7) Casting wall concrete
8) Rebar, formwork, support for top slab
9) Casting top slab concrete
10) Backfilling by using imported soil
11) Granular sub base course
12) Aggregate base course
13) Wearing course

4.7.4 Consultancy Services

(1) Objectives

The objectives of the consulting engineering services are to carry out the following:

- The detailed design works, including cost estimation;
- Pre-construction phase services including review of tender documents;
- Construction supervision including environmental monitoring;
- Technical assistance for operation and maintenance works including the preparation of manuals and the implementation of training for appropriate operation and maintenance after the construction, and;
- Technology Transfer.

(2) Scope of Services

(a) The Detailed Design Phase

Review and Evaluation

This will cover the review of the previously prepared plan and the study results to identify the main points that require further investigation for the preparation of the detailed design.

Survey and Study

(i) Data Collection

To update the required information and data, additional data will be collected and analysed, as follows:

1) Topography: Topographic map with 1 m contour interval.
2) Geology and Soil Mechanics.
3) Hydrology: Rainfall, discharge and flood inundation conditions.
4) River Condition: Saloum River.
5) Existing Drainage Facilities: Canal, manhole and mobile pump.
6) Socio-economy: Future urban development, existing assets and property, road and other public facilities.

(ii) Survey and Investigation

To provide the required data to the study and design, the following survey and investigation shall be carried out:

1) Topographic Survey
   - Route survey for Drainage Box Culvert (8.3 km long; 30 m wide)
   - Cross-section and longitudinal profile (8.3 km; 50 m interval)
   - Topographic survey for Pumping Station (0.5 ha) and Retention Pond (20 ha)
2) Geotechnical Investigation
   - Core boring at site of box culverts (15 holes, 10 m depth each)
   - Core boring at site of pumping station (5 holes, 30 m depth each)
   - Core boring at site of box culvert (3 holes, 15 m depth each)
   - Soil mechanics test (62 samples)
3) Structural Survey
   - Exact location and dimension of existing canals.

(iii) Hydrological and Hydraulic Analysis

The following hydrological analyses are to be done to formulate the definitive plan and design conditions:

- Rainfall Analysis: Duration-Area-Depth Relationship of storm rainfall, together with probability analysis.
- Runoff Computation: Storm water runoff.
- Hydraulic Analysis: Confirmation of retention pond capacity, flow capacity of box culverts and other related matters.

(iv) Structural Analysis

For the detailed structural design, structural analysis for the pumping station and major facilities is to be carried out, as follows:

- Soil Mechanics: Consideration and analysis for pile driving for pumping station, and the coefficient of permeability for retention pond.
- Stability Analysis: For box culverts, manholes and retention pond.

(v) Flood Damage Analysis

The expected flood damage will be reviewed on the basis of the updated hydrological and socio-economic conditions.

Formulation of Definitive Plan

Based on the hydrological data and flood damage analysis, the optimum drainage system will be formulated, as follows:

1) Review of the safety degree of the proposed drainage structures/facilities;
2) Preliminary design of the required structures and facilities;
3) Preliminary cost estimates, and benefit calculation;
4) Economic analysis; and
5) Determination of the definitive drainage improvement plan.

Detailed Design

The detailed design with complete hydraulic and structural computations, drawings, bill of quantities, detailed cost estimates, specifications, pre-qualification documents and tender documents will be carried out for the following works:

(i) Preparatory Works

1) Access road, workshop and warehouse
2) Water and electricity supply
3) Field laboratory and safety facilities

(ii) Civil Works

1) Construction of drainage box culverts
2) Construction of pumping station
3) Construction of retention pond

Preparation of Environmental Monitoring

1) Formation of multipartite monitoring team
2) Preparation of monitoring program
3) Establishment of environmental monitoring and management system

Institutional Improvement Study

Institutional Improvement Study includes the following items:

1) Plan for institutional strengthening of related organizations
2) Operation and maintenance institutions
3) Financial plan for related organizations

(b) Pre-construction Phase

The following matters shall be undertaken in the pre-construction stage:

- Assistance to the Kaolack City Hall for the acceptance and evaluation of pre-qualification documents received from the applicants; and
- Assistance to the Kaolack City Hall for the acceptance and evaluation of the tender documents from tenderers.

(c) Construction Phase

The Consultant will assist the Kaolack City Hall in the supervision of the project construction including but not limited to the following:

Construction Supervision

1) Review and endorsement of proposed plans, designs, schedules and documents related to project implementation and construction which are submitted for approval by the Contractor.
2) Monitoring and reporting to the Kaolack City Hall on the progress of the work and accomplishment in relation to the schedule.
3) File inspection of works as deemed necessary by the Consultant for performance and quality control of works for the Contractor.
4) Establishment of procedures for testing of construction materials and evaluation of tests conducted by the Contractor.
5) Conduct of necessary inspection and testing of materials, manufacture of products and equipment used in the Project.
6) Verification of Contractor's survey, sounding and setting measurements of quantity for interim and final payment.
7) Recommendation to the Kaolack City Hall on the acceptance or rejection of the works, in whole or in part, in accordance with the specifications or conditions of contract.
8) Supervision and inspection of the work for adherence to plans and specifications;
9) Supervision of additional field investigations when required.

10) Advice on the method of measurement and computation of work, and assistance in the verification of contract progress and payment.
11) Supervision of the preparation of as-built drawings by the contractor.

Design Modification

The Consultant shall make revisions, modifications and/or adjustments of designs from time to time and as necessary in accordance with actual field conditions and the comments of the Kaolack City Hall.

Operation and Maintenance Manual

The Consultant shall prepare the operation and maintenance manual of project facilities.

Environmental Monitoring and Management

The Consultant shall carry out the environmental monitoring, evaluation and management during the construction stage.

(3) Reporting

The Consultant shall prepare and submit the following reports and documents to the Kaolack City Hall:

1) Bimonthly Progress Report (20 copies), to present the details of expert personnel mobilization, progress of work, financial man-month used, problems encountered and the anticipated services for the next period of services.
2) Inception Report (20 copies), one (1) month after the commencement of the services, to present the detailed work plan and program of the services including recommendations for possible alternative plans and/or designs, if any, for discussion.
3) Definitive Plan Report (20 copies), four (4) months after commencement of the services, to summarize all the works after completion of the survey, investigation and study on the optimum drainage system including the review of the previous plan.
4) Detailed Design Report (30 copies), twelve (12) months after commencement of the services, to compile all the results of the detailed design works, cost estimation and tender documents. The comments of the Kaolack City Hall shall be given to the Consultant within two (2) weeks after receiving the report.
5) Pre-qualification Evaluation Report (10 copies), two (2) weeks after receipt of Pre-qualification Documents from prospective Applicants, to present the results of the evaluation and to select the qualified applicants.
6) Tender Evaluation Report (10 copies), one (1) month after tender-opening, to present the results of the tenders to select the most responsible contractor.
7) Operation and Maintenance Manual (20 copies), containing technical procedures for the appropriate operation and maintenance of all project facilities.
8) Environmental Monitoring and Management Report (20 copies), every six (6) months after the commencement of the services, presenting the environmental evaluation and management during and after the construction stage.
9) Service Completion Report (50 copies), at the completion of all the consulting engineering services, giving a summary of the services provided and the construction works completed, including as-built drawings of the Project.

(4) Work Schedule

A total of 54 months of consulting engineering services will be required for the Project. Each component of the consulting engineering services, namely; the detailed design, pre-construction, construction and transfer of knowledge shall be completed within the time specified below.

1)	Detailed Design	12 months
2)	Pre-construction	6 months
3)	Construction	36 months
4)	Transfer of Knowledge	1 month

(5) Experts Required

For the consulting engineering services, a total of 322.8 man-months are required for foreign and local consultants as follows:

Table 4.7.1 Experts Required

Item No.	Designation	Man-Month
A.	**Foreign Consultant**	
(1)	Project Manager	21.6
(2)	Drainage Engineer I	21.6
(3)	Structural Engineer I	11.6
(4)	Hydrologist	2.0
(5)	Geologist/Soil Material Engineer I	4.0
(6)	Mechanical Engineer I	2.0
(7)	Electrical Engineer I	2.0
(8)	Architecture I	2.0
(9)	Cost Estimator I	4.0
(10)	Project Economist I	3.0
(11)	Contract Specialist I	3.0
(12)	Construction Engineer I	38.0
(13)	Survey Expert I	4.0
(14)	Environmentalist I	4.0
(15)	Institutional Specialist I	3.0
	Total for A	125.8
B.	**Local Consultant**	
(1)	Co-Project Manager	21.6
(2)	Drainage Engineer II	21.6
(3)	Structural Engineer II	11.6
(4)	Geologist/Soil Material Engineer II	9.6
(5)	Mechanical Engineer II	5.0
(6)	Electrical Engineer II	5.0
(7)	Architect II	3.0
(8)	Cost Estimator II	6.0
(9)	Project Economist II	4.0
(10)	Contract Specialist II	3.0
(11)	Construction Engineer II	19.0
(12)	Survey Expert II	6.0
(13)	Quality Control Engineer	34.0
(14)	Quantity Surveyor	35.0
(15)	Environmentalist II	9.6
(16)	Institutional Specialist II	3.0
	Total for B	197.0
	Total for A + B	322.8

4.7.5 Implementation Schedule

Based on the descriptions in the preceding sub-section, the detailed implementation schedule is formulated as shown in **Fig.4.7.1**.

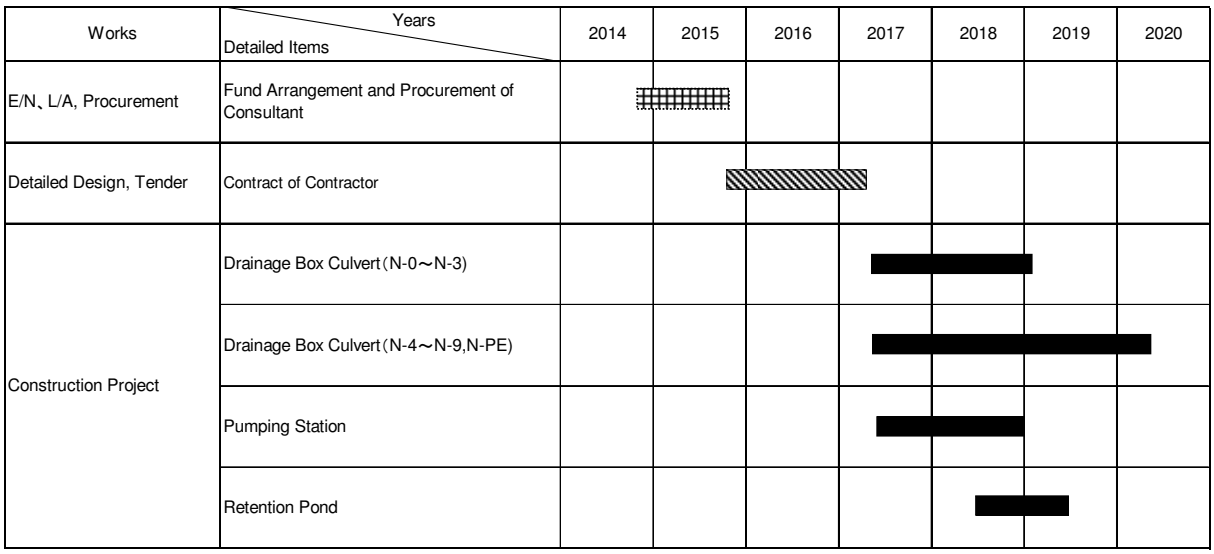


Fig. 4.7.1 Implementation Schedule of Drainage Facilities

4.7.6 Disbursement Schedule

Based on the implementation schedule, the cost disbursement schedule is proposed as shown in **Table 4.7.2**(Construction Cost) and **Table 4.7.3** (Overall Project Cost).

Table.4.7.2 Cost Disbursement Schedule for Drainage Facilities (Construction Cost)

(million FCFA)

Item		Total			2014			2015			2016			2017			2018			2019			2020		
		FC	LC	Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total	FC	LC	Sub-Total
a.	Box Culvert	0	15,295	15,295	0	0	0	0	0	0	0	0	0	0	3,341	3,341	0	5,057	5,057	0	5,163	5,163	0	1,734	1,734
b.	Pumping Station	3,120	1,621	4,741	0	0	0	0	0	0	0	0	0	1,248	648	1,896	1,872	973	2,845	0	0	0	0	0	0
c.	Retention Pond	0	426	426	0	0	0	0	0	0	0	0	0	0	0	0	0	213	213	0	213	213	0	0	0
	Total	3,120	17,342	20,462	0	0	0	0	0	0	0	0	0	1,248	3,989	5,237	1,872	6,243	8,115	0	5,376	5,376	0	1,734	1,734

Table.4.7.3 Cost Disbursement Schedule for Drainage Facilities (Project Cost)

(Unité: Million de FCFA)

	Rubriques	Total			2014			2015			2016			2017			2018			2019			2020		
		FC	LC	Total	ME	ML	Sous -Total	ME	ML	Sous -Total	ME	ML	Sous -Total	ME	ML	Sous -Total	ME	ML	Sous -Total	ME	ML	Sous -Total	ME	ML	Sous -Total
a.	Travaux de construction	3,120	17,342	20,462	0	0	0	0	0	0	0	0	0	1,248	3,989	5,237	1,872	6,243	8,115	0	5,376	5,376	0	1,734	1,734
b.	Indexation des prix	298	2,937	3,235	0	0	0	0	0	0	0	0	0	103	501	604	195	994	1,189	0	1,043	1,043	0	399	399
c.	Imprévu physique	342	2,028	2,370	0	0	0	0	0	0	0	0	0	135	449	584	207	724	931	0	642	642	0	213	213
d.	Services de Consultance	1,301	2,479	3,780	0	0	0	79	94	173	636	866	1,502	191	387	578	169	567	736	169	428	597	57	137	194
e.	Acquisition de terrain	0	379	379	0	0	0	0	0	0	0	225	225	0	154	154	0	0	0	0	0	0	0	0	0
f.	Cout d'Administration	0	604	604	0	0	0	0	3	3	0	35	35	0	143	143	0	219	219	0	153	153	0	51	51
g.	VAT	0	5,372	5,372	0	0	0	0	31	31	0	270	270	0	1,260	1,260	0	1,975	1,975	0	1,379	1,379	0	457	457
h.	Taxe d'Importation	0	339	339	0	0	0	0	0	0	0	0	0	0	134	134	0	205	205	0	0	0	0	0	0
i.	Interet pendant la Construction	1,037	0	1,037	0	0	0	0	0	0	0	0	0	90	0	90	235	0	235	337	0	337	375	0	375
j.	Commission d'engagement	62	0	62	0	0	0	62	0	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	6,160	31,480	37,640	0	0	0	141	128	269	636	1,396	2,032	1,767	7,017	8,784	2,678	10,927	13,605	506	9,021	9,527	432	2,991	3,423

4.8 Operation and Effect Indicators

Operation and effect indicators are set up to evaluate impact of project implementation quantitatively and qualitatively. In order to evaluate the impact of implementing the priority projects in the field of stormwater drainage management, the indicators with the target year of 2022 (two years after the completion of the projects), are set up as shown in the following table.

Table 4.8.1 Operation and Effect Indicators

Operation and Effect Indicators		Unit	Year		Remarks
			2012 (Present)	2022 (Target Year)	
(1) Operation indicators					
	Pump Capacity on North Pumping Station	m^3/s	-	11.1	
	Gross Storage Capacity of Retention Pond	m^3	-	39,000	
(2)-1 Effect indicators (For Project Area)					
	Total inundated area at the maximum rainfall	ha	20	2[5]	
	Total length of drainage main	km	0	8.3	
(2)-2 Effect indicators (For Entire City Center Area)					
	Total inundated area at the maximum rainfall	ha	35	74	
	Total length of drainage main	km	20.0	28.3	

4.9 Project Evaluation

Based on the above discussion, the priority projects of stormwater management are evaluated as follows:

- Inundation area in north area of Kaolack is reduced to one-tenth by installing the proposed drainage system.
- Proposed stormwater conveyance system, which is comprised of box culvert, is better than that of open channel in order to prevent people from dumping garbage to the drainage channels. As a result, sanitary condition in the project area is improved.
- Proposed box culvert, pumping station and retention pond are technically sound in operation and maintenance because no complicated technology is applied.
- No resettlement is required since all proposed facilities are constructed and/or installed under public roads or vacant areas.
- As with the construction works of sewage facilities, negative impacts such as traffic interruption especially in installing box culvert, as well as noise, dust and vibration, would be unavoidable during the construction stage. However, the impacts could be minimized by introducing countermeasures such as setting up diversion road, sprinkling water and selecting low-noise and/or low-vibration type construction equipment as far as practicable.
- To implement the priority projects, financial assistance by Government of Senegal is strongly required.

[5] 10-years design rainfall is adopted for drainage planning. However, in the case of rainfall, it is impossible to avoid the possibility of occurrence of inundation due to the uncertainties such as rainfall in excess of design rainfall, differences in rainfall pattern and change of land use. Assumed inundation area in 2022 is estimated at 10 % of the present inundation area.

CHAPTER 5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In Kaolack City, sewerage system, consisting of sewer network, pumping station and sewage treatment plant, has been in operation since 1980s. The sewerage facilities, in particular sewer pipes, are however gradually deteriorated due to aging and the sewage treatment plant is overloaded by poor maintenance and lack of augmenting treatment capacity. In addition, house connection rate in the sewered area still remains low due to high connection fee.

In order to improve sewerage and sanitation condition in Kaolack City, three alternatives are selected and compared in the Master Plan with evaluation criteria of: sewered population; ease of operation and maintenance/reliability; operation and maintenance cost; environmental impact. Kaolack City is, as a result, divided into two areas: (i) sewerage area and (ii) on-site sanitation area, with 66% and 34% in population for the target year of 2030, in consideration of technical, institutional and financial level of ONAS Kaolack, which is main implementation body.

Based on the planning setup, the Master Plan proposes sewage treatment facilities with total capacity of 21,000 m^3/day applying aerated lagoon method to treat wastewater generation from sewerage area and septage treatment facilities for benefit of on-site sanitation facilities users. Feasibility Study is then conducted targeting trunk sewer, pumping station and sewage treatment plant including rehabilitation of existing lagoon and new construction of aerated lagoon and septage treatment facilities in the expansion area for the target year of 2020.

Kaolack City is vulnerable to floods and stormwater because of its low-lying topography, hydrological conditions and no proper drainage systems. There are some habitual flooding areas. The flood and inundation affected residents, causing traffic and disturbing commercial activities in Kaolack City. Habitual flooding occurs in the depressed topography so that its lowest elevation without stormwater drainage system causes further difficulty to drain out flooded stormwater. The Kaolack City Hall had already installed a drainage system consisting of drainage pipes, open canals and manholes in the city center only. However, the drainage open canals require improvement because they have mostly lost their original drainage capacities by the heavy deposits of solid waste/silt illegally dumped into drainage open canals.

The Master Plan proposes, as the most effective drainage improvement measures, the construction of new drainage facilities for the severe inundation areas and the recovery and improvement of the original drainage capacities by dredging and re-construction of drainage open canals.

The proposed Master Plan and Priority Projects for the Kaolack City are effective in terms of technical, economic, social and environmental aspects for drainage improvement in the Kaolack City. By the implementation of the proposed drainage improvement plan, the severe inundation area will significantly be reduced and improved. It is recommended for the Government of the Senegal to take immediate actions for the implementation of the proposed measures, because the Kaolack City is very important economically and socially in the country.

As for SWM in Kaolack City, some recommendations on issues for further implementation of SWM are given based on the review of the APROSEN Master Plan and the IDB project.

5.2 Recommendations

Various issues have been encountered in the course of the Master Plan formulation and the Feasibility Study. To realize the sound urban environment drawn by the Master Plan and the Feasibility Study for the selected priority projects, these issues shall be resolved in an integrated manner involving wide stakeholders. Thus the following recommendations are given to accelerate project realization.

Expectation of Synergistic Effects

- The Master Plan is the first challenge to improve the overall urban environmental issues in Senegal by integrating the environmental elements, such as wastewater, stormwater and solid wastes. There are three planning components proposed in the Master Plan in accordance with the urban environmental elements, namely; sewer/sanitation system improvement; stormwater drainage management; and solid waste management. Since these three plans are closely related and affect each other, they shall be implemented simultaneously to produce the synergistic effects and realize the sound urban environment expected for Kaolack City.
- The Kaolack City Government had informed that the solid waste management project funded by the IDB will be commenced soon (as of November 2013). Even though the project focuses on short-term improvement of solid waste issues encountered in Kaolack City, the present situation of scattered garbage and many locations of illegal dumping sites in the city will be improved through the project's implementation. Furthermore, garbage accumulated in the drainage canal system will be periodically excavated and transported to the final disposal site using the procured heavy equipment and hauling trucks, contributing to the restoration and recovery of the existing drainage system.
- Following such improvement of urban environment, the proposed sewerage system including sewer treatment plant, septage treatment plant and sewerage network will be constructed sequentially. The wastewater as well as human waste disposal issues affecting, negatively, the residents' living conditions could be solved with the improved and well-functioning sewerage system. If the proposed stormwater drainage system is finally constructed, the urban environment would also completely improve.
- The above-mentioned improvement mechanism utilizing structural measures can attain enhancement of the living conditions as well as the urban environment with the synergistic effects. As a result, the present downward spiral to deterioration of the urban environment could change to upward spiral to sound urban environment of Kaolack City.

Sewerage and Sanitation Improvement

- Since wastewater inflow to the STP is already overloaded to the treatment capacity of it, it is most urgent to rehabilitate the malfunctioning lagoon system, to extend the plant adding an upgraded treatment method (aerated lagoon) and to install the septage treatment plant additionally. After completion of this treatment system, sewer network improvement and expansion could be much easier.
- Branch sewer installation is not included in the priority projects. However, the installation of branch sewer is indispensable to optimize the major facilities such as trunk sewer, pumping stations and sewage treatment plant. ONAS is responsible for the installation of branch sewers, it should look for the financial source for the installation. The financial support may come from donors such as the WB and/or the Government of Senegal through ADM, which involved in the funding of related sewerage projects in Kaolack. The schedule of branch sewer installation will be very challenging to ONAS, based on the construction volume for each year (about 100 ha) and the latest historical achievement of branch sewer installation. For example, about 90 ha was achieved with funds from the WB and 92 ha in the PRECOL area by ADM from 2003 up to the present. Under the circumstances, ONAS would require an extraordinary effort and involvement to secure funds from the available donors and/or the Government of Senegal in order to install the branch sewer network, more than ever.
- Considering low connection ratio of sewer network in Kaolack City, house connection of sewer network should be accelerated by financial assistance of Government of Senegal to optimize the sewerage system.
- The septage desludged from the septic tanks of households without connection to the sewer network is illegally disposed to the dry riverbed even in the dry season due to poor accessibility to the disposal pond. The environment in the areas surrounding the disposal site of Sing Sing District is getting worse every year. Furthermore, the frequency of desludging the septic tanks might become higher compared with the common septic tank in the other area due to the very poor

infiltration capacity of soils in Kaolack City. Therefore, the installation of septage treatment plant is also indispensable in Kaolack City

- Administrative guidance by ONAS as well as Kaolack City to the companies providing desludging service, is strongly recommended to make them utilize septage treatment facilities and thus to reduce their desludging service charge to each household.
- Along with the financial assistance of house connection and administrative guidance, public awareness of sewerage system and sanitation facilities is essential. It is recommendable to disseminate information to the inhabitants about advantage of sewer connection or septic tank installation, advantage of desludging and cost reduction of desludging by the installation of septage treatment facilities in sewage treatment plant.
- At present, ONAS Kaolack records operation and maintenance activities of sewerage facilities such as sewer pipe, pumping station and sewage treatment plant in the Monthly Report. On the other hand, ONAS has no well-organized ledger including information on the exact location of sewer pipe, manhole and house inlet, invert level of pipes and covering and so on. In parallel with the implementation of the project, well-organized ledger shall be formulated using the base map and design drawings prepared in the project.

Stormwater Drainage Management

- The construction works of the new drainage facilities such as drainage box culverts, pumping station and the retention pond, shall be conducted according to the proposed schedule in order to prevent/mitigate the damages caused by floods and inundation in the Kaolack City. The Priority Projects identified in the Master Plan shall require immediate actions, and be conducted duly according to the schedule.
- The existing stormwater drainage facilities are composed of open drains, covered drains and manholes. Most of the drains could not meet their discharge capacities because of heavy deposits caused by illegal dumping of solid waste. Therefore, it is strongly recommended to conduct the proper maintenance works such as cleaning and dredging for the existing drainage.
- At present, the annual maintenance work plan of the STC includes only drainage length to be cleaned. The STC doesn't have existing drainage map and specific data of drainage lines. In order to conduct the proper operation and maintenance work, the cleaning plan will be needed and base map and database will be necessary to prepare the cleaning plan. Therefore, it is recommended to prepare the base map and database for drainage facilities.
- Most of the existing open canals are simply excavated earth canals in unsustainable condition. Therefore, they get easily damaged and collapse. These open canals have large flow capacities so that they are considered as key facilities of the stormwater drainage system and should be sustained by proper rehabilitation, because they have been working effectively in improving the stormwater drainage.
- Public participation should be promoted by enhancement of public awareness for stormwater drainage management in order to improve and maintain the drainage facilities including various community-involved activities.
- The implementing agency shall be decided and organize a coordination committee for the implementation of the Master Plan and Priority Projects, because the implementation of the Master Plan and Priority Projects shall require various concerned central and local government agencies and stakeholders.
- As designed on the stormwater drainage network in the Master Plan, big investment is necessary to install complete drainage system due to flat topography. Meanwhile portable pumps are utilized for draining inundated stormwater in the habitual flooding areas in the rainy season. Two pumps, which were procured through Japan's Program Grant Aid for Environment and Climate Change, are also well working for this purpose in the 2013 rainy season. Such solutions could bridge between inconvenience situations of habitual flooding and necessary big investment as urgent immediate measures. Thus such step-by-step improvement would be necessary for stormwater drainage improvement.

Solid Waste Management

- IDB will support the structural solid waste management system in Kaolack City. In addition, United Nations Industrial Development Organization (UNIDO) utilizing Global Environmental Facility (GEF) would assist the solid waste management in Kaolack City including domestic, medical and industrial wastes, according to recent information. The garbage issues are central in the vicious cycle worsening urban environment, due to clogged canals with thrown garbage, producing offensive odor and deteriorated scenery. Thus the solid waste management could be an engine for synergy effects of enhancing the urban environment, if its management system is well working through proper collaboration of both projects.
- The ROC system is working as the pre-collection process of house garbage. Unless the road conditions particularly the alley conditions are upgraded with asphalt pavement in parallel with the activation of the regional economy, the solid waste management system has to rely on the ROC system for the pre-collection of wastes. Until then, the workable integration of the ROC owners, reasonable coverage of ROC service, and capacity development of ROC drivers are necessary.
- Transfer stations are to be constructed to upgrade the existing illegal dumping sites. Firstly, land ownership shall be solved for land utilization as transfer stations. Afterwards, a well-functioning management system for the stations shall be established in a sustainable manner.
- The hauling system for solid waste from the transfer stations to the final disposal site is also needed to be managed in a sustainable manner with enough budgets.
- After construction of the final disposal site, a site as a sanitary landfill using heavy equipment is also needed to be managed in a sustainable manner with enough budgets.
- Heavy equipment used for solid waste management will normally deteriorate due to the various kinds of waste. Therefore, the workshops shall be upgraded or new ones established for the repair of damaged heavy equipment and hauling trucks. In addition, the workers shall be trained to improve their skill in managing the workshops, properly.

Necessity of People's Awareness of the Environment and their Participation

- People's habit of throwing garbage indiscriminately into the canals or the roadsides is one of the obstacles to the enhancement of urban environment. Although IEC (Information, Education and Communication) campaigns are done by the NGOs, community associations and the City Government, clear effects do not appear in the environment. Such kinds of efforts should be made incessantly in order to eradicate the undesirable habit permanently.
- Participatory activities in a community are also effective to enhance the environment. Residents can help clean the roadsides and open spaces and fill the small-scale depressed lands with soil brought from nearby higher places to solve the small-scale inundation in the rainy season. In parallel with these activities, educational activities to change their consciousness are crucial to develop people's interest in improving the environment through their own efforts.

Strengthening of the Main Actors in Urban Environmental Improvement

- The main actors in the urban environmental improvement are Kaolack City and ONAS Kaolack. Both organizations have similar weaknesses in implementation capability; that is, budgetary constraint and lack of human resources. Against budgetary constraint, there might be no rapidly effective solution except for the central government to increase its subsidies to the local governments and the government-affiliated organizations.
- Structural reform needs a long period, such as taxation and charging system for the collection of sewerage charges. Regarding lack of human resources, some capacity development projects and activities shall be requested from the donors to enhance the actor's poor capacity, by increasing the number of skilled technicians and engineers in the urban environmental management field, in particular.

Immediate tasks of implementation/responsible agencies

- Implementation/responsible agencies for the urban environmental improvement as targeting in the Project are ONAS and Kaolack City. In order to realize the sound urban environment which the

Master Plan and the Feasibility Study delineated, immediate tasks of the both agencies are summarized below.

Agencies	Fields	Immediate Tasks
ONAS	Sewerage Improvement (Sewerage Treatment Plant and Sewer Network)	Year 2014 to 2015 To implement the projects in the both fields, ONAS will find the suitable donors and will prepare the fund arrangement to them.
	Stormwater Management	
Kaolack City	Solid Waste Management	After the year 2014 Through the IDB project for about four years, Kaolack City will establish the solid waste management system, and will make an effort of capacity development and necessary budgetary arrangement to keep the sustainability for the system after completion of the project.

APPENDIX

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

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1. Basic Conditions on Environmental and Social Considerations

1.1. Outline of the Project

Following the official request of the Government of Senegal, the Government of Japan through the Japan International Cooperation Agency (JICA) decided to jointly fund with Senegal, the sanitation project for the management of wastewater, rainwater and solid waste in the City of Kaolack.

With a population of approx. 252,067 inhabitants and a rate of urbanization of 31.7% (ANSD, 2011), only 17,000 residents are connected to the sewage network. The City of Kaolack, located at the crossroads of trade between Senegal, the Gambia and Mali, suffers greatly from its unhealthy situation related to insufficiency of management of wastewater, rainwater and solid waste (see **Fig. 1.1.1**). The current state of sanitation in the city is characterized by a network operated with a 45 km long sewage system by lagoon (with a capacity of 1,200 m^3/day), built in 1981. The system is under operational but not functioning well because of the reduction of capacity.

At the same time, the management of solid waste presents a significant deterioration of collection infrastructure and management systems with collection rate that does not exceed 25%. The city has three transfer sites and a site of disposal, which are actually open dumps not complying with environmental requirements, although the APROSEN support the implementations. They cause many problems and result in severe environmental and human impacts.

To remedy this alarming environmental situation, the Government of Senegal (the City of Kaolack), with technical and financial assistance from the Government of Japan through JICA, decided to update the Sanitation Master Plan of 1979 for a better management of wastewater, rainwater and solid waste in the City of Kaolack in accordance with environmental requirements.

Fig. 1.1.1 Location Map of Kaolack City

1.2. Objectives of the Project

The objectives of the project are as listed below:

- Update the existing plan and an assessment of the current state of the sewer, drainage of rainwater and the state of play in the management of solid waste in Kaolack;
- Formulate the Master Plan of sanitation improvement and rainwater management in Kaolack for the target year of 2030;
- Conduct a feasibility study on the priority projects in the study area; and
- Transfer of skills and technologies useful to staff in charge of the project.

1.3. Activities Requiring Environmental and Social Considerations

Main activities requiring environmental and social considerations in the Project are as follows:

(1) Sewage/Sanitation System Improvement

- Supply of construction materials (sand, cement, iron/steel etc.)
- Dredging, excavation and construction of canals, retention pond and pumping station
- Transportation and disposal of solid wastes from the cleaning basin
- Closure of streets affected by the work

(2) Rainwater Drainage Improvement

- Demolition of asbestos cement pipes
- Evacuation
- Installation of new pipes
- Rehabilitation (expansion) and construction of pumping stations, wastewater/sludge treatment stations

1.4. Categories of the Project and Environmental Impact Assessment

According to the Environmental Code of Senegal, (Law No. 2001-1, January 15, 2001) an Environmental Impact Assessment (EIA) is required for a development project in order to consider of both beneficial and harmful effects. Decree No. 2001-282 on the implementation of the Environmental Code specifies that the EIA should evaluate the impacts on the natural environment as well as the health of population by the project concerned. It may also cover the impacts, particularly, with regard to the specific needs of men/women and specific groups, resettlement of displaced persons, etc.

This Project is categorized as B level because significant adverse impacts on the environment do not seem to be anticipated under the JICA Guidelines for Environmental and Social Consideration (April, 2010) in terms of sectors, characteristics and areas.

1.5. Fundamental Environmental and Social Conditions

1.5.1. Environmental Conditions

(1) Geology

Kaolack City presents an overall low relief ranging between 0 and 10 m and slopes slightly oriented north-south. Covered by the Mauritania–Senegal basin, the main geological formations

encountered in the sector are those of the marine transgressions of the shells of Nouakchottien (5500 years BP) and low plateaus of the continental terminal.

(2) Topography and Land Use

1) Overall

Kaolack City, with the coordinates of 14˚10'57''N and 16˚15'11'' W in West-Central Senegal, lies on the right bank of the Saloum River, 150 km southeast of Dakar. An ocean and river port with an important export trade in peanuts (groundnuts) and salt, is linked by rail with Guinguineo (21 km north-east) and the Dakar-Niger railway. It is also the hub of the road network that serves both the southern and eastern parts of Senegal.

In the city, the central market is located in Leona District, and some local markets are located in Medina District and other districts. Due to the urbanization, legal and illegal occupations have been expanding in north and north-east parts of Kaolack City. Since there are no protected forests, it should be emphasized that the Saloum River is important for wildlife conservation and tourism. In addition, Medina Mosuque is an important cultural heritage in the city.

2) Sewage Treatment Plant (STP) in Koudum

The existing STP project site as well as its expansion site is located in Koudum District, where 279 households with 2,322 people reside. This area is a part of the urbanization zone of Kaolack City, which includes the administrative and commercial areas. The expansion of STP site is planned in the industrial area of Koundam District. There is a recycling plastic factory in the industrial area, but a large part of it is bare land. The City Government plans to establish a protected beach in Koundam District, which is located next to the largest tourist hotel (Hotel Relais) in Kaolack City and the existing STP site. No specific concern like ethnic groups, national or natural parks, precious wildlife and historical memorials have been observed over the area.

3) Pumping Station in Darou Salam Ndangane

The planned pumping station is located at Garage Nioro in Darou Salam Ndangane District, where the commercial center and industrial area south-east of Kaolack City is also located. The location of the site is about 200 m far from a market and 100 m from the main road to Nioro. The place is muddy area with a lot of solid wastes. According to the neighboring residents, nobody had lived in the site. A workshop for dump trucks is next to the site. In the area, concerns mentioned in the STP in Koudum have not been detected.

4) Pumping Station in Boustane

A pumping station is planned in Boustane, the western periphery of Kaolack City and the right side of the trunk road (R1) to Dakar. The area is one of the centers of transportation in Kaolack City, and there is a bus terminal in the south side of R1. The planned site belongs to the area of an Islamic school inside of R1. In the area, concerns mentioned in the other works above have not been detected, either.

5) Retention Pond in Touba Kaolack

The planned retention pond is located at Khakhout in Touba Kaolack District, the right side of the trunk road (R4) to Gossas. Since the land is depressed and unused, it becomes a natural pond during the rainy season. Touba Kaolack District is located in the northern periphery of Kaolack

City, which is characterized with low population and lack of socio-economic and cultural facilities.

6) Pumping Station in Medina Baye

A pumping station site at Medina Fass 2 in Medina Baye District is located in the northern periphery of the city as well. There is a cultural heritage of mosque in the center of the district. The site is located at about 350 m east from the mosque and 300 m from the main road behind the mosque. The area is huge, bare and swampy (tans) lands, and it is difficult to access the site by car in the rainy season.

(3) Climate

The climate of Kaolack belongs to the Sudano-Sahelian rainfall zone ranging between 600 and 700 mm per year with very high temperatures in the range of 35 degrees Celsius. Its rainfall situation is strictly dependent on the migration of the intertropical front to the North. This migration is often accompanied by the alternation of trade winds and flows of the monsoon which occurs in the rainy season that extends over a short period of three to four months and a longer dry season from eight to nine months. Precipitation begins usually at the end of June with rainfall in the order of 40 mm, and then reaches in the order of about 130-244 mm per month in July, August and September as shown in **Fig. 1.5.1**. The rainy season ends in October with 54 mm rainfall. Recorded rainfall between the months of June and October represents the bulk of annual rainfall water masses. However, trace amount of rains is recorded from November to February.

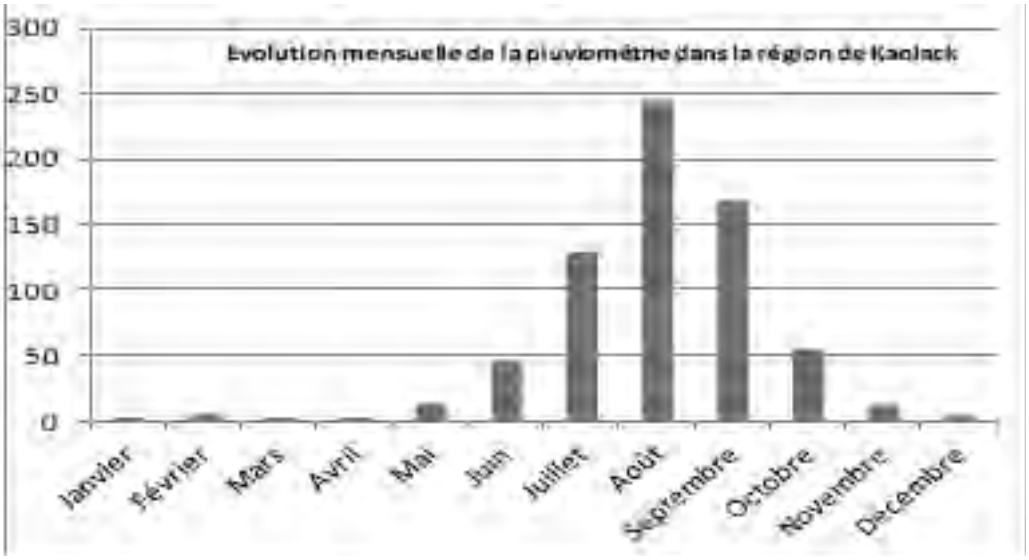

Fig. 1.5.1 Average Monthly Changes in Rainfall in Kaolack

Average temperatures vary between 26 and 31 degrees of Celsius. The highest temperatures often mark in April, May and June during the dry season, and the monthly ranges are 17-20 degrees Celsius. In the rainy season monthly average temperatures are below 30 degrees.

Relative humidity is high during winter with maximum values of about 72% (July), 79% (August and September) and 71% (October) relating to the high evaporation and the weakness of the wind speed at this time. However, during the dry season, relative humidity is at low rate between 38 and 63%, and this is related to the action of the hot and dry continental trade winds which absorb the

bulk of moisture from the atmosphere.

(4) Hydrology

The hydrological situation is characterized by the presence of the layers in the Eocene, limestone in the Paleocene and sands in the Maastrichtian. The Continental terminal flushes at the end of the watershed to the South. Its depth varies from 80 to 160 m. Water is of good quality in chemistry and with quite a satisfactory rate of 25 m3/h. The layers of the Eocene and Paleocene limestone overlap throughout the region. The Eocene water is generally unfit for consumption and is found at depths of 50 to 150 m.

(5) Soil

There are three types of soil: the salt, hydromorphic and ferruginous soils.

- Salt soils have a heavily modified pedogenic development both at level of composition, structure and texture. These are initially silty in nature like those in mangroves, rich organic soils, with slightly acidic or alkaline pH.
- Hydromorphic soils are also encountered in low-lying areas and areas rich in clay bowls. They are often referred to as the “Deck” with some shades of “Dior”.
- Ferruginous soils with two variants are encountered mainly in the Department of Kaolack and are generally for the culture of peanut. These soils have two types of variants. The first variant is composed of the leached tropical ferruginous soil and the second variant consisting of non-leached tropical soils.

(6) Fauna and Flora

1) Fauna

The wildlife of the region consists mainly of wild animals (terrestrial and aquatic avifauna) feathered small reptiles and wild mammals. Concerning the zone of study (which is an industrial area), in the vicinity of major works animals consists of small reptiles (lizards, snakes etc.).

2) Flora

The plant diversity in the region is described as follows:

- Bush lands consisting mainly of Guierra senegalensis, Combretum sp of Balanites aegyptiaca, lannea acida, Bauhinia rufescens of Adansonia digitata, Anogeissus leocarpus of acacias various, Tamarix senegalensis, Acacia seyal. Regarding the grass carpet, it is composed mainly of very primed species.
- Grassland vegetation which consists generally of Sudanian type species that can reach 12 to 20 m in height including Cordyla pinnata, Pterocarpus erinaceus, Daniella oliveri of Parkia biglobosa, Tamarindus indica, Prosopis africana of Stercuiia setigera, Parinari macrophylla . However, it the land is used as a large colony of herbaceous plants usually operated with the grazing passage livestock.
- Mangrove area in regression against the tanning of land.

1.5.2. Social Environment

(1) Demographic Characteristic of Kaolack

According to the general population and habitat (RGPH) census of 1988, Kaolack had more than

150,000 inhabitants. This number rose in 2002 to more than 240,000 inhabitants. In 2003, the Directorate of Forecasting and Statistics (DFS) estimated 259,282 inhabitants while the APROSEN assessed it in 2007 to 255,334 inhabitants.

Even if the demographics still remain to be specified, the growth of the population remains stable. This reflects in part by city crossroads of Kaolack status between the other regions of Senegal and neighboring countries (Mali, Gambia, Guinea). It also seems far from slow down under the rate of intercensal population growth of 3.5 per cent per year. The population of Kaolack is young (58.21% less than 20 years and 73% less than 30 years). The breakdown by sex shows that women remain a majority with 51.90% compared to men consisting of 48.10% of the population (Source: UN-Habitat, 2009).

(2) Macro Economic Context

On the geographical and administrative aspects, Kaolack City lies in the center of the country because of its location. Indeed it has common boundaries with the region (Fatick to the North and to the West and the region of Kaffrine in the East) and a border to the South with the Republic of the Gambia. It is a place of transit products such as rice, sugar, tea, tissues, etc. The result is an intensification of the activities at the level of Central Kaolack Market which is one of the most important in West Africa. Its status as groundnut basin already gives the economic influence of the municipality by the creation of trading houses, the development of the port and to the creation of the SONACOS.

1) The Primary Sector

The sector occupies 75% of the population and engages in crops such as groundnut, watermelon, cowpea, sorghum, corn, sesame, rice and vegetable crops. Industrial crops or products are dominated by the peanuts.

Types of livestock consist of cattle, sheep, goats, horses, pigs, and poultry. Two types of fishing practiced in the region are sea fishing and inland fishing. Marine fishery produces about 800 tons of fish a year and the major regional consumption comes from other regions. Since inland fishing is practiced in the lakes and ponds in the region, it has negligible production.

2) The Secondary Sector

The secondary sector employs a total of 30.7% of the active population in Kaolack (16.1% for the food industries, 8.6% for crafts and other productions and 6% for the building and public works). The commune includes three industrial hubs: (i) The SONACOS factory, based in Lyndiane, on the Western outskirts of the town. It employs 180 full-time and contractual personnel, which vary in number depending on the size of crop. (ii) The salt of Kaolack is a production of iodized salt company (large tonnage). The refining and iodization unit is located in Rufisque. The production capacity is 27,000 tons per year. (iii) The industrial field of Kaolack (SODIKA) is based in Kasnack. With the exception of a car repair plant, this industrial zone is now inactive. Senegalese industry of mopeds is established, next to the port.

3) The Tertiary Sector

The tertiary sector largely dominates the local economy. It employs 65.2% of employees (45.3% in public and private administration, 10.1% by transport, and 7.1% per trade and banking activities). Commercial equipment of the commune of Kaolack consists of:

- 1 central market;

- 8 markets in neighborhoods;
- 2 bus stations;
- 1 slaughterhouse;
- 20 shopping streets;
- 2 main hotels.

The central market, located in the District of Leona, is surrounded by shopping streets. Its reach is nationwide throughout the town and even the sub-region with regard to its geographical position: it is indeed the passage for the South and Southeast regions of Senegal and neighboring countries. The market has 525 souks, 186 canteens, 2,100 occupants of the public domain and 320 occupants of the highway. Other market districts, small-scale, are to Ndorong OCAS, Zinc to Leona, and plots of Assainies Kibbel. Finally, it is important to note that from the entrance of the estuary silting has reduced the activity of the Port of Kaolack, access is now available to shallow draught vessels.

(3) Health and Hygiene (Garbage Treatment)

1) Health Policy

The health policy is based on the Constitution, which stipulates in Article 17 that "the State and the public authorities have the social duty to ensure the physical, moral and mental health of the family." The policies of a series of measures tending to a better sector devolution are displayed by the State, in the interests of fairness, to make accessible services health database to the entire population regardless of their economic and social conditions.

2) Garbage Treatment

The management of solid wastes in local communities of Kaolack arises with acuity. Indeed, local communities in the region face enormous difficulties to properly play the role of collection and disposal of household waste. In general most of the local communities in the region ensure the collection of household waste using rudimentary and insufficient means. They design, organize and finance sector they perform in part with their own technical and financial capabilities. Moreover, the decentralized image of the APROSEN services provides a technical and sometimes logistical support. Community-based organizations are involved, mostly in information and awareness-raising operations and very little in collection (Set Setal), contrary to the strategy and the private sector involved in the pre-collection.

In Kaolack City, thanks to the support of the NGO (ASDES, Caritas, Jant Boubess) and some ASC, solid wastes are being managed with the system of waste collection by carts (ROC). However, the weakness of logistical, financial and human resources inhibits all the activities in the system.

2. Environmental Laws and Organizations Related to EIA

2.1. Environmental Laws

2.1.1. The Environmental Code of Senegal (Law No.2001-1 of January 15, 2001)

(1) Environmental Impact Assessment

Chapter V of the Environmental Code consists of the definitions and describes the mandate and the processes of Environmental Impact Assessment.

Article L48: Any development project or activity likely to harm the environment, as well as policies, plans, programs, regional and sectorial studies shall be subjected to an environmental assessment. The strategic environmental assessment aims at assessing the environmental impacts of decisions made in policies, plans and programs, as well as their alternatives.

Article L49: The impact assessment fits in existing procedures for authorization, approval and concession granting. The impact assessment shall be established and incurred by the promoter. It shall be submitted to the Environmental Ministry, which delivers an authorization certificate following the technical advice of the DEEC.

Article R 38: Impact assessments shall be carried out prior to any required administrative authorization for the conduct of the activity considered.

Article R 40: The scope and categories of environmental impact studies are divided into two classes:

Class 1: Projects which are likely to have significant impacts on the environment; studies assessing the impacts on the environment including environmental considerations in economic and financial projects. This category requires an environmental assessment.

Class 2: Projects which have limited impacts on the environment, the impacts can be mitigated by implementing measures or changes in their design. This category is subject to initial environmental review.

Moreover, the Environmental Code clearly mentions the importance of people's participation and public hearing through the process of Environmental Impact study, which is explained form Article 52 to 54 in Chapter V, Part II.

The detailed procedure on disclosure about EIA is described in Article 6 R Chapter II, Title VI, Part III as follows:

The application for authorization of facilities in the first class is subjected to a public inquiry decided by a decision of the Governor of the related Region for a period of 15 days.

This survey shall be announced in advance, five days before the launching.

1. By the posters which indicate the system of the survey, mentioning the date of commencement and duration of the survey, reference and which are to be publicized finally.
2. By advertisements in newspapers, radio, and national TV broadcasting.

2.1.2. The Environmental Code Related to the Project

(1) Noise

The legislation on Noise is included in the Environmental Code of 2001 and the Decree

No. 2006-1252 of 15 November 2006.The decree specifies in its Article 13 that 'the level of noise exposure must be as low as possible and should remain in an intensity limit that would not have any risk to harm the workers' health, particularly their sense of hearing.

Article 14 of the same decree specifies that if it is impossible to reduce the daily noise level of resonant exposure below 85db (A), the employer must provide for individual protection equipment to the workers. The employer has to assure that workers are really used to the noise level. The daily limit of exposure is 85db (A).

(2) Asbestos

The demolition of old sewer pipes will produce a big quantity of asbestos wastes. It will also put laborers in contact with the risks of breathing dust containing asbestos.

There is no specific regulation for wastes with asbestos fiber in Senegal.

However, Law No. 2001-01 related to the Environmental Code depicts that wastes should be eliminated or recycled in an ecological and rational way in order to reduce their harmful effects on human health, the natural resources, the fauna and flora and environment quality.

Senegalese legislation specifies that hazardous wastes be treated in a global standard way. Wastes containing asbestos belong to hazardous ones.

Concerning laborers engaged in demolition works, Decree No. 2006-1259 of 15 November 2006 depicts the employer's obligations in terms of safety during works. It states in its Article 10, "Equipment of individual protection adapted to the incurred risks must be provided to the workers. They must be kept in perfect functioning condition. The employer must assure that the workers are trained on that usage and that they are using it perfectly." For that purpose, some masks must be provided to the workers for protection against asbestos dust. The employer is obliged to supervise the wearing of protection equipment.

2.1.3. Revision of the Environmental Code

According to the DEEC and ONAS in Dakar, the Environmental Code of Senegal has been under revision work because the Code is outdated and the gap between the laws and actual situations has been widening. For instance, Article 13, Part II, Chapter I describes as follows:

"Facilities placed in the first class should be the subject, before their construction or installation, of authorization issued for development by order of the Minister in charge of environment in the conditions fixed by decree. For this authorization, the location of the facilities should keep at least a radius of 500 m of distance of homes, buildings usually occupied by third parties, public buildings and areas for housing, a stream, a lake, a communication channel, a water catchment."

However, the schedule of finalization and enforcement of the new Code is not publicized yet.

2.2. Estrangement from JICA's Guidelines

- EIA study is mandated for First Class Projects by the Environmental Code of Senegal and also the JICA's category A. However, it was found that EIA has not been conducted properly for a few STP projects through the field survey. For instance, the STP project in the region has been implemented without EIA and operation started in 2007. Another case was the STP construction project at Richard-Tall in Saint Louis Region where IEE was conducted in the planning phase, but it was not sufficient. The construction works has been continuing since 2011. The EIA was started simultaneously in May 2013.

- DEEC and DREEC are not able to control each and every project due to limitation of capacity and manpower. Therefore, conducting EIA study is highly depending on the project promoters' and related organizations' attitude and knowledge about the Environmental Code. Because of the huge costs and the long time consumed in the implementation of an EIA study, the procedures for validation of the report are a heavy burden for promoters especially in local areas due to the shortage of logistics such as transportation, printing materials and so on.
- Regarding involuntary resettlement, the World Bank's operational manual OP4.12 (recommended compliance by JICA Guidelines for Environmental and Social Considerations 2010) advances farther than the Senegalese regulation. Those manual and guidelines advocate that the land provided to the dislodge people should be equivalent to the land taken from them (See Land Acquisition and Compensation).

2.3. Roles of Environmental Organizations

2.3.1. Ministry of Environment and Sustainable Development

The Ministry of Environment, Protection of Nature, Retention Ponds and Artificial Lakes (MEPLBA) was reorganized into the **Ministry of Environment and Sustainable Development** in October 2012 as a part of the administration reform in the Government of Senegal. The new ministry prepares and implements the policy defined by the Head of State on ecology, environmental monitoring, protection of nature, fauna and flora, as well as in the field of aquaculture and retention basins

2.3.2. The Directorate of Environment and Classified and Establishment (DEEC)

DEEC is under the Ministry of Environment and Sustainable Development. The duties and responsibilities of DEEC are as follows:

- To implement ways and means to ensure the prevention and control of pollution and nuisance,
- To follow activities of the various services and agencies involved in the field of the environment,
- To develop the laws and regulations concerning the environment, and
- To promote energy efficiency for a better protection of the environment through sound management of its resources.

DEEC consists of three divisions:

- Division of Prevention and Control of Pollution and Nuisance
- Division of Legal Affairs
- Division of Environmental Impact Assessments

The duties and responsibilities of the Division of Environmental Impact Assessments are as follows:

- To validate the terms of reference of the EIA/ SEA of projects;
- To administer the EIA;
- To ensure the follow up and implementation of environmental management plans; and
- To give a technical opinion on projects submitted and to prepare for the Minister of Environment and Sustainable Development decisions on the environmental compliance certificate and to perform as the Secretariat of the Technical Committee for EIA/SEA, public hearing and the commission on accreditation for the exercise of activities related to EIAs.

2.3.3. The Regional Division of Environment and Classified Establishments (DREEC) of Kaolack

The DREEC is composed of five agents including the Head of the Division and his assistants. The head is in charge of the Secretariat of the Regional Environmental Monitoring Committee of Development Projects. The DREEC Kaolack also collaborates with the Regional Council and the City Council of Kaolack in giving technical support.

2.3.4. The Regional Environmental Monitoring Committee of Development Projects in Kaolack

The Governor of Kaolack has set up a regional Environmental Monitoring Committee for Development Projects by the Order of 13 August 2010. The Committee is chaired by the Governor in person. The Head of DREEC plays the role of Secretariat. The Committee includes all regional technical services related to environmental issues. It holds a meeting whenever needed, on the Governor's notification, and can invite any person whose competence is judged relevant to the project implementation. The main missions are:

- To ensure that the environmental dimension be taken into consideration in development projects.
- To ensure the effective implementation of the recommendations made in the screening sheets.
- To ensure that the follow-up be conducted in environmental and social projects.
- To ensure that a technical support and advice be provided to owners concerning the environmental and social impacts of projects.

Cooperation with this Committee is unavoidable for implementation of this Project to improve sanitation in Kaolack City.

Stakeholders in Kaolack City are described in the Master Plan.

2.3.5. Dissolution of APROSEN

APROSEN has been an autonomous public organization for managing and providing technical support to the solid waste management of the Ministry of Environment, Protection of Nature, Retention Ponds and Artificial Lakes (MEPLBA). After change of the national government administration in Senegal, APROSEN was dissolved in 2012 and the responsibility for solid waste management was transferred to the local governments such as the City of Kaolack.

3. Impact Predictions

Lists of impacts predicted on the project regarding both environmental and social issues are shown in **Table 3.1.1** for sewage/sanitation system improvement and in **Table 3.1.2** for rainwater drainage management.

Table 3.1.1 Impact Predictions on Sewage/Sanitation System Improvement

Category		Impact Items	Evaluation			Reasons for Evaluation
			PC	C	O	
Pollution	1	Air Quality	N	B-	N	The main concern is disposal of replaced asbestos pipe, but the disposal amount is expected limited and the diffusion of asbestos could be minimized by way of disposing pipes without crushing.
	2	Water Quality	N	B-	A+	**Construction**: Water pollution may be caused by discharged water from construction sites of STP, pumping stations and sewer network.
						Operation: Water quality will be appropriately improved by wastewater and sewage treatment.
	3	Wastes	N	B-	B-	**Construction**: Amount of wastes such as excavated soil, solid wastes, old asbestos sewer pipes, and debris from demolition of existing STP facilities, are concerned.
						Operation: STP (especially sewage treatment facilities) produces sludge, which could be reused for agriculture to reduce the amount of wastes.
	4	Soil Contamination	N	B-	A+	**Construction**: Soil contamination is expected, due to oil leakage, solid wastes and so on.
						Operation: Soil pollution might be reduced by operation of sewage treatment felicities, especially farm fields in Shin Shin district where untreated filth is illegally discharged.
	5	Noise and Vibration	N	B-	C-	**Construction**: Noise and vibration from trucks and machineries will be matters of concern.
						Operation: Minor noise from operation of aerated lagoon and pumps is predicted.
	6	Ground Subsidence	N	N	N	No significant impact is expected.
	7	Offensive Odor	N	B-	B+/-	**Construction**: Odor is predicted around the reconstruction site of STP and replacement of sewer network.
						Operation: Offensive odor will be reduced in the whole Kaolack City. However, there is apprehension that offensive odor (such as NH_3 and H_2S) might increase around the sewage treatment facilities.
	8	Bottom Sediment	N	B-	N	Excavated soil exposed to rainfall may flow to the existing canals and the Saloum River and cause sedimentation.
Natural environment	9	Sanctuary	N	C-	C-	Currently, there is no protected area around the project site. (However, Kaolack City has a plan to establish a protected beach in Koundam District, so that some negative and/or positive impacts during construction are expected in the area in the operation phase.)
	10	Ecosystem	N	B-	A+	**Construction**: STP and pumping stations, and sewer network construction works cause the partial loss of vegetation and habitat for birds.
						Operation: Ecosystem in farmland and Saloum River might be improved by reduction of untreated wastewater and septage.
	11	Hydrology	N	B-	N	Direction of surface drain might be changed around the STP.
	12	Topography and Geology	N	B-	C+	**Construction**: Earth work for construction of the new STP in extension area might cause impacts on topography and geology.
						Operation: Facilities may change the topography but the impacts are expected minor.

Category	Impact Items		Evaluation			Reasons for Evaluation
			PC	C	O	
Social environment	13	Resettlement	N	N	N	No significant impact is expected.
	14	Vulnerable social groups such as women, children, and the poor	N	B-	A+	**Construction**: Activities of vulnerable people might be disturbed during construction in terms of access to their livelihood
						Operation: Vulnerable people living in the sewer network installation area might be benefited due to the improvement of sanitation.
	15	Ethnic minorities and Indigenous peoples	N	N	N	No significant impact is anticipated because there are not any ethnic groups in the project area.
	16	Local economy such as employment, livelihood, etc.	N	B+/-	A+	**Construction**: Opportunities for employment and local economy will be improved. However, sales of shops and tourist hotels around the STP site will be negatively affected.
						Operation: Livelihood might improve due to the reduction of nuisance.
	17	Land use and Utilization of local resources	B-	B-	B+/-	**Pre-construction**: Land acquisition process might take time due to the disagreement of major stakeholders such as local community of Koundam District.
						Construction: Complaints might ensue from residents around the STP expansion area in Koundam District.
						Operation: Farmland utilization will improve due to reduction of illegal discharge of sewage.
	18	Water Usage	N	N	C+	In case of re-use of treated water, positive impact on agricultural field is predicted.
	19	Existing social infrastructure and Services	N	B-	B+	**Construction**: Construction works may disturb access to schools, mosque and so on.
						Operation: Existing social infrastructure and services will improve due to reduction of nuisance.
	20	Social institutions as social infrastructure and Local decision making institutions	N	B-	N	There are schools and government offices that may be affected during the construction of pumping stations and installation of sewer network system along the trunk roads (R1 and R4).
	21	Misdistribution of benefits and Damages	B-	B-	B-	Through the implementation of the Project, especially residents in Koundam District especially might complain about the construction of STP in their area without receiving any benefit from the Project. Alternative plans might be required for residents in Koundam District for the smooth operation of the Project.
	22	Local conflicts of interests	B-	B-	B+/-	**Pre-construction, Construction and Operation**: Some impacts like livelihood disturbance may be a source of local conflicts among the residents.
						Operation: Conflicts due to illegal discharge of sewage may be reduced.
	23	Heritage	N	N	N	No significant impact is anticipated because there is not any historical heritage found in the project area.
	24	Landscape	N	B-	C+/-	**Construction**: Landscape at the STP site in Koundam District and sewer network area will be affected.
						Operation: Negative impacts on landscape are expected due to the construction of the new STP.
	25	Traffic	N	B-	N	The traffic congestion is expected during construction work, especially, the national trunk road (R1 and R4) and the road around the STP site.
	26	Health and Hygiene	N	B-	A+	**Construction**: Some health problems are expected due to the air pollution.
						Operation: Generally, the spread of waterborne diseases such as cholera and typhoid fever would be reduced by the improvement of sanitary conditions around the project.
	27	Infectious Diseases such as HIV/AIDS	N	C-	N	(A) Hired person(s) carrying an infectious disease for manual labor could spread it among the work group.

Category		Impact Items	Evaluation			Reasons for Evaluation
			PC	C	O	
Social Environment	28	Working Conditions	N	B-	B+	**Construction**: Working conditions should be in accordance with existing law and adequate regulations.
						Operation: Reconstruction of STP and installation of a new sewer network might improve working conditions for maintenance.
Others	29	Accident prevention measures	N	B-	N	Safety regulations should be applied during construction activities.
	30	Trans-boundary impacts and Climate change	N	N	C+	Emission rate of gas (such as methane) of sewage treatment plant is much lower than those of septic tanks, and hence greenhouse effect might be minimal.

Note: PC: Pre-construction Stage, C: Construction Stage, O: Operation Stage
A+/-: Significant positive/negative impact is expected
B+/-: Positive/negative impact is expected to some extent
C+/-: Extent of positive/negative impact is unknown
N : No impact is expected

Table 3.1.2 Impact Predictions on Rainwater Drainage Management

Category		Impact Items	Evaluation			Reason for Evaluation
			PC	C	O	
Pollution	1	Air Quality	N	B-	N	During construction, there will be some exhaust emission and suspended particles from trucks and machineries.
	2	Water Quality	N	B-	B+	**Construction**: Minor water contamination is prospected.
						Operation: Water pollution could be reduced by the reduction of flood in the operation phase.
	3	Wastes	N	B-	B-	**Construction**: Excavated soil and solid wastes management are needed.
						Operation: Removal of sediment is required in order to maintain the retention pond.
	4	Soil Contamination	N	B-	B+	**Construction**: Soil contamination would happen due to the oil leakage from construction machineries.
						Operation: Soil contamination by floods could be mitigated.
	5	Noise and Vibration	N	B-	C-	**Construction**: There will be noise and vibration from trucks and machines.
						Operation: Minor noise is expected especially from pumping station during the rainy season.
	6	Ground Subsidence	N	N	N	No significant impact is expected.
	7	Odor	N	N	C-	Malfunctioning of retention pond might cause minor odor during the rainy season.
	8	Bottom Sediment	N	B-	B-	**Construction**: Excavated soil might cause the sedimentation.
						Operation: Some sediment accumulates at the bottom of retention pond.
Natural environment	9	Sanctuary	N	N	N	No significant impact is expected.
	10	Ecosystem	N	C-	C+	**Construction**: slight impacts on ecosystem are expected around retention pond site.
						Operation: Some aquatic life and plant species might be propagated in and around the retention pond.
	11	Hydrology	N	B-	B+	**Construction**: Surface drainage is affected by construction of retention pond and drainage facilities installation.
						Operation: Hydrological condition might be improved by the construction of drainage system.
	12	Topography and Geology	N	C-	N	Excavated soil could be a part of road and sidewalks.

Category	Impact Items		Evaluation			Reason for Evaluation
			PC	C	O	
Social environment	13	Resettlement	N	N	N	No significant impact is expected.
	14	Vulnerable social groups such as women, children, and the poor	N	C-	A+	**Construction**: Construction works might disturb the activities of vulnerable people.
						Operation: Commuting for children and working along the streets sides for women would be easier due to the reduction of floods.
	15	Ethnic minorities and Indigenous peoples	N	N	N	No significant impact is anticipated because there are not any ethnic groups in the project area.
	16	Local economy such as employment, livelihood, etc.	N	B+	A+	**Construction**: Some local people will have opportunities for employment during the construction phase.
						Operation: Economic loss by the floods might be reduced and livelihood could be improved.
	17	Land use and Utilization of local resources	B-	B-	B+	**Pre-construction and Construction**: Residents at Khakhout in Touba Kaolack District might complain about the construction of retention pond. In particular, they concern about the overflow in case of malfunctioning of the pond.
						Operation: The land use opportunities could be improved throughout the years.
	18	Water Usage	N	N	N	No significant impact is expected.
	19	Existing social infrastructure and Services	N	B-	N	Construction works is possible to disturb the operation of institutions such as mosque etc.
	20	Social institutions as social infrastructure and Local decision making institutions	N	B-	N	Some schools and several offices may be affected by construction of the drainage system especially in Touba Kaolack and Medina Baye Districts.
	21	Misdistribution of benefits and Ddamages	N	B-	B-	**Construction**: Residents in Dialegne II which is located at downstream of the Project site, might concern about the overflow of existing clogged canals, unless Kaolack City remove the sediments in the canals.
						Operation: Periodical removal of sediments by Kaolack City is required for existing canals before and during the Project.
	22	Local conflicts of interests	B-	B-	B-	**Pre-construction and Construction**: Residents at Khakhout in Touba Kaolack District might complain about the construction of retention pond.
						Operation: Conflicts might be reduced in the Touba Kaolack District in the operation phase. On the other hand, complaints and conflicts are expected from rainwater discharged area in Dialegne II.
	23	Heritage	N	N	N	No significant impact is expected.
	24	Landscape	N	B-	B+	**Construction**: Landscape would be changed during the construction of retention pond.
						Operation: Improvement of landscape around the retention pond is expected due to the flood control in Kakhout.
	25	Traffic	N	B-	B-	**Construction**: Traffic congestion along the national trunk road (R4) in Touba Kaolack District is expected.
						Operation: The traffic problems due to floods would be mitigated especially during the rainy season.
	26	Health and Hygiene	N	N	B+/-	Generally, waterborne diseases (malaria, diarrhea and so on) will be reduced by improvement of sanitation in the Project site. The outbreak of malaria in Touba Kaolack might be caused unless the retention pond is properly maintained.
	27	Infectious diseases such as HIV/AIDS	N	C-	N	During construction, hiring the local people for labor work might prevent the infection diseases.

Category	Impact Items		Evaluation			Reason for Evaluation
			PC	C	O	
Social Environment	28	Working conditions	N	B-	B+	**Construction**: Working condition should be prepared in accordance with adequate regulations. **Operation**: Working conditions will be improved during the rainy season.
Others	29	Accident prevention measures	N	B-	C-	**Construction**: Safety regulations should be applied during construction works. **Operation**: Maintenance of the fence around retention pond is essential in order to prevent people from dropping and drowning in the pond.
	30	Trans-boundary impacts and Climate change	N	N	B+	Negative effects from flood due to climate change could be reduced by the construction of retention pond and drainage system.

Note: PC: Pre-construction Stage, C: Construction Stage, O: Operation Stage
A+/-: Significant positive/negative impact is expected
B+/-: Positive/negative impact is expected to some extent
C+/-: Extent of positive/negative impact is unknown
N : No impact is expected

4. Mitigation Plan

Table 4.1.1 and **Table 4.1.2** show possible plans for mitigating or minimizing the impacts on environmental and social concerns that may occur.

Table 4.1.1 Mitigation Plan for Sewage/Sanitation System Improvement

Category	Potential Impact	Objectives of Measures	Mitigation/Minimizing Measures
Pre-Construction Stage			
Social environment	Resettlement	·To prevent social unrest	·To determine forms of compensation
	Local economy	·To prevent social unrest and decrease illegal livelihood in the project sites.	·To determine forms of compensation.
	Land use and utilization of local resources	·To prevent social unrest and to comply with urban regulations in and around planned STP area.	·To follow land acquisition process prepared by relevant agencies. ·To discuss with the residents in Koundam about the reuse of treated water for agriculture, etc. ·To negotiate and agree with Regional Custom Office to acquire land.
	Local conflicts of interests	·To prevent conflict of interest and stir up a positive opinion about the Project.	·To organize meetings with the residents in Koundam District for explaining the benefit of the Project. ·Alternative small scale on-site sanitation project might be proposed to motivate residents in Koundam. ·Supplemental infrastructures such as road and street lights are improved around the STP sites for local people.
Construction Stage			
Pollution	Air quality	·To reduce the effect of air pollution. ·To protect local people and construction workers from absorbing asbestos.	·Dump trucks carrying excavated soil should be covered with tarpaulins. ·To conduct watering in the construction sites (STP, pumping stations and sewer network system) especially in the dry season in order to reduce the high dust concentration. ·To distribute masks to the local people and construction workers in order to prevent from absorbing asbestos.
	Waste	·To manage excavated soil and solid waste, and sludge in the project sites. ·To regulate use of the old asbestos pipes in the project sites. ·To manage human wastes in the Project sites.	·Immediately to remove the soil, solid wastes and asbestos pipes from the construction sites, and transport to the designated disposal site. ·To construct portable toilets and installation of garbage cans in the construction sites.
	Water quality	·To avoid negative impacts on quality of surface water	·To build a sediment trap to prevent run-off water that flows from expansion area from causing and increasing in turbidity. ·To pick up and transport excavated soil along the sewers immediately.
	Odor	·To reduce adverse effects on surrounding environment caused by odor.	·To make public announcements and discussions with neighboring communities. ·To schedule and limit working hours for construction.
	Soil contamination and erosion	·To avoid soil contamination and erosion.	·To provide garbage cans at the base camp to place domestic waste. ·To prevent oil spills from construction equipment to comply with the Environmental Code of Senegal ·To construct toilets for construction workers. ·To control the weight of loading and heavy equipment.
	Noise and vibration	·To reduce noise and vibration impacts.	·To limit construction activities (at locations bordering on populated areas) only during the day so as not to interfere surrounding community.
	Bottom sediment	·To prevent the occurrence of bottom sediment in canals and the river	· To pick up and transport the excavated soil to the designated area immediately.

Category	Potential Impact	Objectives of Measures	Mitigation/Minimizing Measures
Natural environment	Ecosystem	·To reduce the impacts on terrestrial fauna and flora.	·For the land preparation, to remove vegetation should be very limited and trees are planted surrounding the Project sites.
	Hydrology	·To prevent soils from disturbing drainage flow.	·To prevent soils from entering into river and drainage canals.
	Topography and geography	·To reduce interference of roads and pedestrians	·Immediately to pick up and relocate excavated soil along the sewers.
Social environment	Local economy	·To minimize negative impacts and to maximize positive impacts towards livelihoods.	·To identify the needs of the manpower and the potential local manpower that can be recruited. ·To identify local contractors who can be partners/subcontractors in Project activity.
	Land use	·To reduce impact on land use	·To replant trees around the beach. ·To inform the community of the construction purpose and schedule. ·To achieve agreement about actions needed to decrease the discomfort and disturbance for the access to infrastructures.
	Existing social infrastructure	·To prevent the existing social infrastructure from being interfered with construction activity in Koundam District. ·To prevent traffic congestion at the pumping stations, and network system construction sites.	·To schedule heavy equipment mobilization. ·To establish detour, traffic signs, boards and warning lights at the entrance of construction sites. ·To minimize excavated areas on public road especially in installing sewer pipes and removing the excavated soil as fast as possible. ·To utilize temporary material such as sheet piles as far as practicable. ·To coordinate with local authorities such as police, city hall and local organizations.
	Social institutions	·To minimize the expected impacts due to construction activity.	·To inform the community that interference would only be temporary. ·To establish signs or directions so that the community would be more aware of the sewer installation activity.
	Misdistribution of benefits and damages	·To minimizing the possibility of social unrest due to the misdistribution of benefits and damages.	·Alternative small scale on-site sanitation project might be proposed to motivate residents in Koundam. ·To reuse treated water for agriculture etc. in Koundam District. ·To recruit local people around the construction sites.
	Landscape	·To reduce landscape impacts	·To relocate excavated soil to avoid traffic jams and the possibility of siltation in the surrounding area immediately.
	Vulnerable people (women, children, and poor)	·To avoid disturbing vulnerable people's activity at the beach, in Koundam District. ·To reduce impacts on the poor due to construction activity.	·To maintain beach for vulnerable people.
	Working condition	·To maintain environment to comply with the regulations.	·To comply with the labor laws in Senegal. ·To refer to the EIA report.
Others	Accident prevention measures	·To avoid work accidents.	·To provide safety equipment such as masks, gloves, and goggles in order to protect from asbestos. ·To install sign posts, warning lights at the entrance of construction sites. ·To implement safety training for construction workers. ·To refer the EIA report.
Operation Stage			
Pollution	Water quality	·To avoid surface water pollution	·To select and install appropriate equipment, stand-by facilities, by-pass channels and generators for emergency use. ·To form a lining on the surface of lagoons in STP. ·To keep water-tightness of discharge pipes in STP. ·To check and maintain equipment, facilities of STP, and sewer network system. ·To train workers of ONAS to manage chlorine appropriately.

Category	Potential Impact	Objectives of Measures	Mitigation/Minimizing Measures
	Noise and vibration	·To avoid adverse effects of noise and vibration on the surrounding environment.	·To control the time for operation. ·To maintain equipment.
	Waste	·To promote the use of sludge produced from the sewage treatment facilities.	·To reuse the sludge from sewage treatment facilities and distribute them to local farmers.
	Odor	·To reduce adverse effects on the surrounding environment caused by odor.	·To lay out aerated lagoons inside the sedimentation lagoon area in the STP. ·To create hedges around the STP, by plants such as Eucalyptus, Moringa, Prosopis, Parkingsonia, Acasia Melifera (common trees for hedge in Senegal).
Social environ-ment	Working condition	·To avoid the emergence of diseases on workers due to STP operation. ·To avoid accidents by mismanagement of chorine.	·To use masks, boots and gloves for workers. ·To implement safety training for workers. ·To do routine medical checkup for workers.

Table 4.1.2 Mitigation Plan for Rainwater Drainage Management

Category	Potential Impact	Objectives of Measures	Mitigation/Minimizing Measures
Pre-Construction Stage			
Social environment	Resettlement	·To prevent social unrest	·To determine forms of compensation
	Local economy	·To prevent social unrest and decrease in illegal livelihood in the Project sites.	·To determine forms of compensation.
	Land use and utilization of local resources	·To prevent social unrest and to comply with urban regulations in and around planned retention pond and pumping station.	·To follow land acquisition process prepared by relevant agencies. ·To communicate especially with the residents in Touba Kaolack, and Medina Baye Districts.
	Local conflicts of interests	·To prevent conflict of interest and stir up a positive opinion about the Project.	·To organize meetings with the residents in Dialeng II District for explaining the benefit of the Project. ·To clean canals by Kaolack City in order to prevent the canal from overflowing by discharged water.
Construction Stage			
Pollution	Air quality	·To reduce the effect of air pollution.	·Dump trucks carrying excavated soil should be covered with tarpaulins. ·To conduct watering in the construction sites (retention pond, pumping station, and drainage facilities) especially in the dry season to reduce the high dust concentration. ·To distribute masks to the construction workers.
	Waste	·To manage excavated soil and solid waste, in the projects sites, especially retention pond area.	·Immediately to remove the excavated soil and solid wastes from the construction sites, and transport them to the designated areas. ·To provide garbage cans in the construction site ·To construct portable toilets in the construction sites.
	Water quality	·To avoid negative impacts on quality of surface water	·To build a sediment trap to prevent water from flowing into canals not to cause and increase in turbidity. ·Immediately to pick up and transport the excavated soil along the streets.
	Soil contami-nation and erosion	·To avoid soil contamination and erosion.	·To prevent oil spills from construction equipment to comply with Environmental Code of Senegal ·To construct toilets for construction workers. ·To control the weight of loading and heavy equipment.
	Noise and vibration	·To reduce noise and vibration impacts.	·Limit construction activity (at location borders to population) only during the day not to interfere with the surrounding community.
	Bottom sediment	·To preventing the occurrence of bottom sediment in canals and the river	·Immediately to pick up and transporting the excavated soil to the designated area.
Natural environment	Ecosystem	·To reduce the impacts on terrestrial fauna and flora.	·To plant trees surrounding the Project sites.
	Hydrology	·To prevent soils from disturbing drainage flow.	·To prevent soils from entering into river and drainage canals.
	Topography and geography	·To reduce interference of roads and pedestrians	·Immediately to relocate excavated soil.
Social environment	Local economy	·To minimize negative impacts and to maximize positive impacts towards livelihoods.	·To identify the needs of the manpower and the potential local manpower that can be recruited. ·To identify local contractors who can be partners/subcontractors in Project activity.
	Land use	·To reduce impact on land use	·To inform the community of the construction purpose and schedule ·To achieve agreement about actions needed to decrease the discomfort and disturbance for the access to the infrastructures.
	Existing social infrastructure	·To prevent the existing social infrastructure from being	·To schedule heavy equipment mobilization. ·To establish detour, traffic sings, boards and warning

Category	Potential Impact	Objectives of Measures	Mitigation/Minimizing Measures
		interfered with construction activity in Touba Kaolack and Medina Baye Districts. ·To prevent traffic congestion especially along the national trunk road (R4) in Touba Kaolack District.	lights at the entrance of construction sites. ·To minimize the excavated area on the public road especially in installing sewer pipes and remove the excavated soil as fast as possible. ·To utilize temporary material such as sheet piles as far as practicable. ·To communicate with local authorities such as police, city hall and local organizations.
	Social institutions	·To minimize the expected impacts due to construction activity.	·To inform the community that the interference would only be temporary. ·To establish sings or directions so that community would be more aware of the drainage facilities installation activity.
	Misdistribution of benefits and damages	·To minimizing the possibility of social unrest due to the misdistribution of benefits and damages.	·To clean existing canals in Dianleng II District. ·To recruit local people around the construction sites.
	Landscape	·To reduce landscape impacts	·To relocate immediately excavated soil to avoid traffic jams and the possibility of siltation in the existing canals.
	Vulnerable people (women, children, and poor)	·To reduce impacts on the poor due to construction activity.	·To install sign posts and make fence around the construction area especially retention pond.
	Working condition	·To maintain the environment to comply with the regulations	·To comply with the labor laws in Senegal. ·To refer the EIA report.
Others	Accident prevention measures	·To avoid work accidents.	·To provide safety equipment such as masks, gloves, and goggles. ·To install sign posts, warning lights at the entrance of construction sites. ·To implement safety training for construction workers. ·To refer the EIA report.
Operation Stage			
Pollution	Water quality	·To avoid surface water pollution	·To select and install appropriate equipment and generators. ·To clean retention pond and drainages. ·To check and maintain facilities.
	Noise and vibration	·To avoiding adverse effects on the surrounding environment by noise and vibration.	·To control the time for operation. ·To maintain equipment.
	Waste	·To prevent the contamination and malfunction of retention pond, pumping station and drainage from discarded wastes.	·To conduct regular cleaning activities for the retention pond, pumping station, and drainage (Box Culvert and existing open channels at the discharge point of the pumping station). ·To make public information and awareness training for local people.
	Odor	·To reduce adverse effects on surrounding environment caused by odor.	·To keep clean the retention pond.
Social environment	Working condition	·To avoid accidents during the maintenance of the retention pond.	·To use masks, boots and gloves for workers. ·To implement safety training for workers. ·To do routine medical checkup for workers.
	Accident prevention measures	·To prevent children and adults from dropping and drowning in the retention pond.	·To construct and maintain a fence (about 2 m height) with barbed wires around the retention pond. ·To make public information and awareness training for local people.
	Protect from malaria	·To prevent residents especially at Kahaunt in Touba Kaolack District from malaria.	·To maintain and clean the retention pond. ·To distribute insecticide-treated nets to neighboring households of the retention pond.

5. Monitoring Plan

5.1. Monitoring Plan

Table 5.1.1 and **Table 5.1.2** show monitoring plans to realize the mitigation described in Chapter 4.

Table 5.1.1 Monitoring Plan for Sewage/Sanitation System Improvement

Category	Potential Impact	Items and Methods	Sites and Frequency	Evaluation Criteria
Pre-Construction Stage				
Social environment	Resettlement	·Number of community complaints. ·Method: Interview.	·Illegal resettlement in the planned project sites twice during pre-construction phase.	·No complaint or unrest on land acquisition. ·Compliance with the Environmental Code, Part II Chapter II ·Compliance with Law No. 76-67 of July 02 on expropriation for public utility purpose
	Local economy	·Perceptions of those who acquire compensation. ·Number of community complaints toward the proponent. ·Method: Interview.	·STP, pumping stations and sewer network areas, twice during pre-construction phase.	·No complaint or unrest from community.
	Land use and utilization of local resources	·Community preparation of land acquisition process. ·Community perception toward disturbance to greenery plants. ·Number of community complaints toward the proponents ·Method: Interview.	·For Koundam District, twice during pre-construction phase	·No complaint or unrest on land acquisition. ·Compliance with the Environmental Code, Part II Chapter II.
	Local conflicts of interests	·Community perception toward the institution that supports the community in terms of STP construction plan, and the expected improvement of local environment. ·Method: Interview.	·For Koundam District, twice during pre-construction phase.	·No conflicts or conflicts in Koundam District.
Construction Stage				
Pollution	Air quality	·Dust content ·Method: Gravimetric.	·For STP, pumping stations and sewer network system sites, once every 3 months during construction phase.	·Compliance with the Environmental Code Part III Chapter II, Title V.
	Wastes	·Soil, solid wastes and old asbestos pipes. ·Method: Observation.	·For STP, pumping stations, and sewer network system sites, once every 3 months during construction phase.	·Compliance with Environmental Code, Part II, Chapters III &IV, Part III, Chapter V.
	Water quality	·Total suspended solid and turbidity. ·Method: Gravimetric and turbid metric.	·At rainwater canals and the Saloum River, once every 3 months during construction period.	·Compliance with the Environmental Code, Part III, Chapter I.

Category	Potential Impact	Items and Methods	Sites and Frequency	Evaluation Criteria
	Odor	·Reconstruction of STP and sewer network sites. ·Nearby neighborhoods. ·Method: Interview	·When required	·Compliance with Environmental Code of Senegal, Part III, Chapter II.
Pollution	Soil contamination and erosion	·Waste stacks and oil spills ·Method: Observation.	·For STP, pumping stations and sewer network areas, once every 3 months during construction phase.	·Compliance with the Environmental Code Part III, Chapter III.
	Noise and Vibration	·Noise and vibration levels ·Method: Sound level meter and vibration meter	·For STP, pumping stations and sewer network areas, once every 3 months during construction phase. ·For neighboring places to STP, pumping stations and sewer network areas, once every 3 months during construction phase.	·Environmental Code, Chapter IV, Title VI.
	Bottom sediment	·Turbidity ·Method: Turbid metric	·For rainwater canals and the Saloum River, once every 3 month.	·Compliance with Environmental Code, Part III, Chapter I, Title III.
Natural environment	Ecosystem	·Greenery total area ·Plant density in greenery area ·Method: Observation	·For the Saloum River beach in Koundum District, once 3 months during construction phase.	·Environmental Code of Senegal, Title V, Chapter III.
	Hydrology	·Condition of drainage channel ·Method: Observation	·For Passed by sewer network installation, every 3 months during construction phase.	·No floods or puddles.
	Topography and geography	·Soil piles condition ·Method: Observation	·For STP and pumping station sites passed by sewer network installation, every 3 months during construction phase.	·There are no soil piles that could disturb road users and pedestrians.
Social environment	Local economy	·Community perception toward employment and business opportunities during construction phase ·Community income comparison between before and during construction phase ·Number of community complaints toward proponent ·Method: Interview.	·For neighborhoods of the STP and sewer network system construction areas, once every 3 months during construction phase.	·No complaint or unrest from community. ·Increase in domestic income.
	Land use	·Community perception of the disturbance of the main roads ·Number of community complaints toward proponent ·Method: Interview	·For mainly trunk roads (R1 and R4) sides, and Koundam District, once every 3 months during construction phase.	·No complaint from community.

Category	Potential Impact	Items and Methods	Sites and Frequency	Evaluation Criteria
	Existing social infrastructure	·Traffic volume and congestion ·Method: Observation	·For STP area and pumping stations, and sewer network sites on R1 and R4 streets, once every 3 months during construction phase.	·Increase of traffic volume and congestion.
Social environment	Social institutions	·Observation towards community perception of the disturbance towards social-institution–owned facilities due to sewer network installation activity ·Method: Interview	·For STP, pumping stations, and sewer network installation areas, once every 3months during construction phase.	·No complain or unrest
	Misdistribution of benefits and damages	·Community perception ·Method: Interview	·For local population near STP site, once every 3 months during construction phase.	·No complaint or unrest from community.
	Landscape	·Whether or not there are excavated soil ·Method: Observation	·For STP, pumping stations, and sewer network sites, every 3 months during construction phase.	·Soil piles that could harm the surrounding plants.
	Vulnerable people (women, children, and poor)	·Community perception toward disturbance to vulnerable people especially in Koundam District and sewer network installation areas ·Number of complaints conveyed to government or proponent of the Project ·Methods: Observation and interview	·For people in Koundam District and sewer network installation areas, once in every 3 months during construction phase.	·Number of complaints from local people and local authorities.
	Working condition	·Work condition ·Method: Observation	·For STP construction sites, every 3 months during construction phase.	·Compliance with Labor Code (No.124 to No.2006-1261) in Senegal.
Others	Accident prevention measures	·The use of safety equipment at work ·Method: Observation	·For project locations, every 3 months during construction phase.	·Compliance with Labor Code (No.124 to No.2006-1261) in Senegal.
Operation Stage				
Pollution	Water quality	·BOD_5, $CODc_r$, TSS, and fecal coliform ·Method: Chemical analysis	·For STP effluent, at least 4 times in a year.	·Compliance with Environmental Code of Senegal, Part III, Chapter I.
	Odor	·Around STP site. ·Nearby neighborhoods. ·Method: Interview	·When required	·Compliance with Environmental Code in Senegal, Part III, Chapter II.
	Noise and vibration	·Noise and vibration ·Method: sound level meter and vibration meter	·Vicinity of noise generating equipment (aerated lagoons, pumps, etc.).	·Compliance with Environmental Code of Senegal, Part III, Chapter IV.
	Wastes	·Sludge used ·Method: Record of sewage treatment facilities and observation	·Sewage treatment facilities area, local farmers.	·Compliance with Environmental Code of Senegal Part II Chapter III.

Category	Potential Impact	Items and Methods	Sites and Frequency	Evaluation Criteria
Social environment	Working condition	·Work condition, use of safety tools ·Methods: Observation, checklist	·For STP, 3 months during operational phase.	·The Labor Code of Senegal No. 97-17, 1997, and No. 2006-1249 to 2006-1261.

Table 5.1.2 Monitoring Plan for Rainwater Drainage Management

Category	Potential Impact	Items and Methods	Sites and Frequency	Evaluation Criteria
Pre-construction Stage				
Social environment	Resettlement	·Number of community complaints ·Method: Interview	·Illegal resettlements at Khakhout in Touba Kaolack District and at Dedina Fass 2, Medina Baye District, twice during pre-construction phase.	·No complaints or unrest on land acquisition. ·Compliance with the Environmental Code, Part II, Chapter II ·Compliance with Law No. 76-67 of July 02 on expropriation for public utility purpose
	Local economy	·Perceptions of those who acquire compensation ·Number of community complaints toward the proponent ·Method: Interview	·For the retention pond, pumping station and drainage facilities areas, twice during pre-construction phase.	·No complaint or unrest from community.
	Land use and utilization of local resources	·Community perception toward disturbance to greenery plants ·Number of community complaints toward the proponents ·Method: Interview	·For Touba Kaolack and Medina Baye Districts, twice during pre-conduction phase	·No complaint or unrest on land acquisition. ·Compliance with the Environmental Code, Part II Chapter II. ·Compliance with Law No. 76-67 of July 2 on expropriation for public utility purpose
	Local conflicts of interests	·Community perception toward the institution that supports the community in terms of pumping station construction plan, and the expected improvement of local environment ·Method: Interview	·For existing canals in Dialeng II District, twice during pre-construction phase.	·No conflict.
Construction Stage				
Pollution	Air quality	·Dust content ·Method: Gravimetric	·For retention pond, pumping station and drainage facilities sites, once every 3 months during construction phase.	·Compliance with the Environmental Code, Part III, Chapter II, Title V.
	Wastes	·Soil and solid wastes ·Method: Observation	·For retention pond, pumping station and drainage facility areas, once every 3 months during construction phase.	·Compliance with Environmental Code, Part II, Chapters III &IV, Part III, Chapter V.
	Water quality	·Total suspended solid and turbidity	·At existing rainwater canals and the Saloum	·Compliance with the Environmental Code,

Category	Potential Impact	Items and Methods	Sites and Frequency	Evaluation Criteria
		·Method: Gravimetric and turbid metric ·Method: Observation	River, once every 3 months during construction period	Part III Chapter I.
	Soil contamination and erosion	·Waste stacks and oil spills ·Method: Observation	·For retention pond, pumping station and drainage facility areas, once every 3 months during construction phase.	·Compliance with the Environmental Code Part III Chapter III.
Pollution	Noise and Vibration	·Noise and vibration levels ·Method: Sound level meter and vibration meter	·For retention pond, pumping stations, and drainage facility areas, once every 3 months during construction phase ·For place neighboring the retention pond, pumping station and drainage facility areas, once every 3 months during construction phase	·Environmental Code Chapter IV, Title VI.
	Bottom sediment	·Turbidity ·Method: Turbid metric	·Existing canals and the Saloum River, once every 3 months.	·Compliance with Environmental Code, Part III, Chapter I, Title III.
Natural environment	Ecosystem	·Road side trees ·Method: Observation	·For retention pond, pumping station, and drainage network, once every 3 months during construction phase.	·Environmental Code of Senegal, Part II, Chapter III
	Hydrology	·Condition of existing drainage channel ·Method: Observation	·For bypass sewer network installation, once every 3 months during construction phase.	·No floods or puddles.
	Topography and geography	·Soil piles condition. ·Method: Observation	·For bypass sewer network installation, once every 3 months during construction phase.	·There are no soil piles that could disturb road users and pedestrians.
Social environment	Local economy	·Community perception toward employment and business opportunities during construction phase ·Community income comparison between before and during construction phase ·Number of community complaints toward proponent ·Method: Interview	·For neighborhood of retention pond pumping station, and drainage facility construction areas, once every 3 months during construction phase.	·No complaint or unrest from community. ·Increase in domestic income.

Category	Potential Impact	Items and Methods	Sites and Frequency	Evaluation Criteria
	Land use	·Community perception of the disturbance of the main roads ·Number of community complaints toward proponent ·Method: Interview	·Along the trunk road (R4) sides in Touba Kaolack District, and around the mosque Madina Baye District, once every 3 months during construction phase.	·No complaint from community.
	Existing social infrastructure	·Traffic volume and congestion ·Method: Observation	·For retention pond and pumping station, and drainage facility areas, especially road side of R4, every 3 months during construction phase.	·Increase of traffic volume and congestion.
Social environment	Social institutions	·Observation towards community perception of the disturbance towards social-institution–owned facilities due to sewer network installation activity ·Method: Interview	·For retention pond, pumping station, and drainage facility installation areas, once every 3 months during construction phase.	·No complain or unrest
	Misdistribution of benefits and damages	·Community perception ·Method: Interview	·For local population near pumping station in Medina Baye site, once every 3 months during construction phase.	·No complaint or unrest from community.
	Landscape	·Whether or not there are excavated soil ·Method: Observation	·For retention pond, pumping station and drainage facility sites, once every 3 months during construction phase.	·Excavated soil that could harm the surrounding plan.
	Vulnerable people (women, children, and poor)	·Community perception toward disturbance to vulnerable people (children, young people, and women's group, poor) in Touba Kaolack and Medina Baye Districts ·Number of complaints conveyed to government or proponent of the Project ·Methods: Observation and interview.	·For people in Touba Kaolack and Medina Baye Districts, once every 3 months during construction phase.	·Number of complaints from local people and local authorities.
	Working condition	·Work condition ·Method: Observation	·For retention pond, pumping station , and drainage facility construction sites, every 3 months during construction phase	·Compliance with Labor Code of Senegal (No.124 to No.2006-1261).
Others	Accident prevention measures	·The use of safety equipment at work ·Method: Observation	·For project locations, every 3 months during construction phase.	·Compliance with Labor Code of Senegal (No.124 to No.2006-1261).

Category	Potential Impact	Items and Methods	Sites and Frequency	Evaluation Criteria
Operation Stage				
Pollution	Water quality	·Water flow ·Method: Observation and record	·For pumping station effluent, every month during operation phase in rainy season.	·Compliance with Environmental Code of Senegal, Part III Chapter I.
	Noise and vibration	·Noise and vibration ·Method: sound level meter and vibration meter	·For pumping station vicinity of noise generating equipment (pumps, etc.), every month during operation phase in rainy season.	·Compliance with Environmental Code of Senegal, Part III Chapter IV.
	Wastes	·Type and volume of wastes ·Method: Observation	·For retention pond, local end and beginning of dry season.	·Compliance with Environmental Code of Senegal Part II Chapter III.
Pollution	Odor	·Retention pond ·Method: Observation	·For retention pond area and nearby neighborhoods, once every month during operational phase especially in rainy season.	·Compliance with Environmental Code in Senegal, Part III, Chapter II.
Social environment	Working condition	·Work condition, the use of safety tools ·Methods: Observation, checklist	·For retention pond, every time during maintenance work	·The Labor Code of Senegal No 97-17 1997, and No 2006-1249 to 2006-1261.
	Accident prevention measures	·Maintenance of fences and security Methods: Observation	·For retention pond, when required	·No accident.
	Protection from malaria	·Neighboring households of the retention pond Methods: Observation	·At Khaout in Touba Kaolack District, every 3 months. ·Hospitals/clinics.	·No outbreak of malaria.

5.2. Estimated Monitoring Cost

The EIA report presents the cost estimation for management measures adopted for monitoring which include both projects (sewerage system improvement and stormwater management improvement), as summarized in the table below.

Table 5.2.3 Estimated Monitoring Cost

Risks	Monitoring Items	Cost (FCFA)
Biophysical Environment	Erosion and salinization	2,000,000
	Conservation of local biodiversity	
	Performance of wastewater treatment and sludge	2,500,000
	Status of warning signs and orientation around the site	
Impacts on the local economic, social and regional environment	Community involvement in the compensation process	175,000,000
	Public awareness and ownership of the project	
	Health, hygiene and safety of people	
Total		179,500,000

6. Stakeholders Meeting for Environmental Impact Assessment Process

According to the Environmental Code of Senegal, the EIA study should be conducted by a qualified national consultant company (Quartz-Afrique) since June 2013.

The first Technical Committee meeting for validation of the TOR for the EIA study was held on the 13th of June 2013 at the Governor's Office in Kaolack Region. About 30 representatives from various governmental and non-governmental organizations not only from Kaolack, but also Dakar, participated in the meeting. The TOR was approved by DEEC/DREEC, and the EIA study was started in June 2013. The validation and comments on the TOR was submitted by DEEC on the 30th day of August 2013. The first draft of the EIA report was revised according to the comments from DEEC/DREEC and the JICA Expert Team.

The second Technical Committee meeting for validation of EIA report was held on the 26th day of September 2013, and validated the EIA report with conditions.

7. Land Acquisition and Compensation

7.1. Current Status of Land in the Project Sites

Basically, this Project does not need any involuntary resettlement. The following survey was conducted as a reference.

In Senegal, when the number of dislodged people reaches 200, the Resettlement Action Plan document for the implementation of some projects should be formulated by a consultant, and compensation will be handled by the proponent. In that case, the Resettlement Action Plan along with EIA should be formulated and validated.

According to the result of the survey conducted by CADASTRE (Kaolack Regional Office for Finance and Monetary) in September 2013, there is no residential house in the planned project sites including those for new STP, pumping stations, and retention pond. In addition, almost all sites, including the new STP site, belong to the State Government of Senegal. However, several private plots have been identified even in the Industrial Area in which the extension of the STP is planned, and plots of land for retention pond all belong to private owners, as shown in the following tables. Therefore, the official land acquisition process must be taken according to the related laws and regulations of Senegal.

Table 7.1.1 Ownership of Extension Area of STP

Lot Number	Area/Size(m^2)	Nature of Property	Owner	Development	Land Value (FCFA)	Building Cost Estimate (FCFA)
a) Land Status of land neighboring the existing STP						
605	6 000	not Awarded	STATE OF SENEGAL	Naked	150 000 000	
606	6 000	not Awarded	STATE OF SENEGAL	Naked	150 000 000	
614	6 000	not Awarded	STATE OF SENEGAL	Naked	150 000 000	
615	6 000	not Awarded	STATE OF SENEGAL	Naked	150 000 000	
621/P	6 000	not Awarded	STATE OF SENEGAL	Naked	150 000 000	
622	6 000	not Awarded	STATE OF SENEGAL	Naked	150 000 000	
629/P	6 000	not Awarded	STATE OF SENEGAL	Naked	150 000 000	
DOUANE	6 000	Allocated	Customs Office	Demolished Building	150 000 000	
HL/1	1 225	Certificate of Award	HORIZONS BLEUS	Boundary wall	30 625 000	5 000 000
HL/2	1 400	Certificate of Award	YOUSSOUPHA NDIAYE	Naked	35 000 000	
b) Land Status of the expansion area of the STP						
607bisA1	324	Certificate of Award	NON IDENTIFIE	Naked	8 100 000	
607bisA2	300	Certificate of Award	NON IDENTIFIE	Naked	7 500 000	
607bisA3	344	Certificate of Award	IBRAHIMA KEBE	Naked	8 600 000	
607bisA4	324	Certificate of Award	NON IDENTIFIE	Naked	8 100 000	
607bisA5	435	Certificate of Award	OUSMANE KA	Naked	10 875 000	
607bisb1	505	Certificate of Award	IBRAHIMA SYLLA	Boundary wall	12 625 000	10 000 000
607bisb2	568	Certificate of Award	NON IDENTIFIE	Naked	14 200 000	
607bisC	797	Certificate of Award	NON IDENTIFIE	Naked	19 925 000	
607bisD1	246	Certificate of Award	NON IDENTIFIE	Naked	6 150 000	
607bisD2	225	Certificate of Award	NON IDENTIFIE	Naked	5 625 000	
607bisE	280	Certificate of Award	LAMINE DIENG	Naked	7 000 000	
607bisF	306	Certificate of Award	NON IDENTIFIE	Naked	7 650 000	
607bisG	306	Certificate of Award	AMADOU SY	Naked	7 650 000	
607bisH	306	Certificate of Award	MANSOUR DIOUF	Naked	7 650 000	
607bisI	403	Certificate of Award	NON IDENTIFIE	Naked	10 075 000	
607bisJ	306	Certificate of Award	MANSOUR DIOUF	Naked	7 650 000	
607bisM	313	Certificate of Award	OUSMANE THIAM	Naked	7 825 000	
607bisL	313	Certificate of Award	NON IDENTIFIE	Naked	7 825 000	
607bisK	625	Certificate of Award	NON IDENTIFIE	Naked	15 625 000	

OBSERVATION: The Customs Office plans to build on its site a regional management office

Table 7.1.2 Ownership of Pumping Station Site in Boustane

Lot Number	Area/Size(m^2)	Nature of Property	Owner	Development	Land Value (FCFA)	Building Cost Estimate (FCFA)
HL	625	Lease Application	EPA/Institut Islamique K.E.H.M.N	Naked	7 812 500	

OBSERVATION: The GIE EPA and Mr. Mohammed Ibrahim NIASS have both filed an application for a lease of the site.

Table 7.1.3 Ownership of Pumping Station Site in Darou Salam Ndangane

Lot Number	Area/Size(m^2)	Nature of Property	Owner	Development	Land Value (FCFA)	Building Cost Estimate (FCFA)
HL	144	TF 2487/KK	STATE OF SENEGAL	Naked	1 440 000 F	

Table 7.1.4 Ownership of Retention Pond Site in Touba Kaolack

Lot Number	Area/Size(m^2)	Nature of Property	Owner	Development	Land Value (FCFA)	Building Cost Estimate (FCFA)
a) Property right of the basin area						
5083 A	250	Certificate of Award	FATOU GAYE	Naked	3 125 000	
5083 B	250	Certificate of Award	MARIAMA LO	Naked	3 125 000	
5084	374	Certificate of Award	DJEUMB TOURE	Naked	4 687 000	
5085	371	Certificate of Award	YACINE SECK	Naked	4 637 000	
5086 A	205	Certificate of Award	BINETOU GAYE	Naked	2 562 500	
5086 B	205	Certificate of Award	DAME DIOP	Naked	2 562 500	
5087	463	Certificate of Award	DIABEL NDIAYE	Naked	5 787 500	
5131	421	Certificate of Award	NDIENDE THIAM	Naked	5 262 500	
R/1	1816	Certificate of Award	STATE OF SENEGAL	Naked	22 700 000	
R/2	777	Certificate of Award	STATE OF SENEGAL	Naked	712 500	
b) Location of land for houses surrounding the retention pond						
5075 A	268	Certificate of Award	EL HADJI BABOU CISSE	Built	3 350 000	
5077 B	266	Certificate of Award	MAGUETTE NDIAYE	Built	3 325 000	
5079	240	Certificate of Award	IBRA DIOP	Built	3 000 000	
5079 A	241	Certificate of Award	MODOU THIAW	Built	3 012 500	
5082 A	300	Certificate of Award	BALLA SEYE	Built	3 750 000	
5082 B	199	Certificate of Award	CHEIKH ANTA DIONGUE	Built	2 487 500	
5082bisA et B	530	Certificate of Award	EL HADJI IBRAHIMA DIA	Built	6 625 000	
5101 B	238	Certificate of Award	TOUBA NDIAYE	Built	2 975 000	
51O7 A	224	Certificate of Award	MAMADOU DIONE	Built	2 800 000	
5129	442	Certificate of Award	NDONGO SECK	Built	5 525 000	
5080 Ter	89	Certificate of Award	MATAR DIA	Built	1 112 500	

Table 7.1.5 Ownership of Drainage Pumping Station in Médina Fass 2

Lot Number	Area/Size(m^2)	Nature of Property	Owner	Development	Land Value (FCFA)	Building Cost Estimate (FCFA)
HL	4 000	TF 6550/KK	STATE OF SENEGAL	Naked	60 000 000	

7.2. Related Laws and Regulations

Law No. 76-66 of 2 July 1976, the State Owned Property Code, might be applied for the Project, which is related to expropriation of public utility and other public utility land operations, and Decree No. 64-573 of 10 July 1964 regulates the conditions of application of national land law. The law mentions two types of compensations as below:

- Compensation in cash, which must be sufficient to compensate all the prejudice that the victim suffer from
- Compensation in kind in case of dislodging, which allows the affected person to receive an equivalent plot as compensation.

In terms of public expropriation, the World Bank Operational Manual OP4.12 (recommended compliance by JICA Guidelines for Environmental and Social Considerations 2010) advances farther than the Senegalese regulation. The manual and guidelines advocate that land to be proposed for dislodged people should be provided with productive potential, geographical advantages and other advantages equivalent to the land taken from them.

7.2.1. Conditions of Compensation Admission

Law No. 76-67 of 2 July 1976 related to the expropriation for public utility and other public utility land exploitations, advocates compensation for expropriated building owners and real rights holders. This law does not cover people having personal rights.

However, Decree No. 91 938 August 1991 modifying Article 38 of Decree No. 64-532 of 30 July 1964 covers all occupants, even irregular ones subject to dislodging for compensation.

Law 76 stipulates, in case of property loss, the compensation is decided based on the properties consistent with the minutes for inventory of fixtures.

However, the improvement of any nature conducted on the properties prior to the minutes of meeting are not subjected to any compensation if it seems that they were realized in order to obtain a higher compensation

7.2.2. The Expropriation Process for Public Utilities

In Senegal, public utility expropriation is regulated by Law No.76-67 of July7 1976 related to public utility expropriation and other land exploitations and other for public utility. It advocates a specific process to be followed by those who conduct the expropriation.

(1) The Relocation of Public Utilities

The relocation of public utilities is to be pursued after an interview survey with the affected people has been conducted. The commencement of the interview should be announced in public to allow the people to prepare their observations. It is announced by Decree.

- The public utility relocation decree
- Publicizing of the relocation decree of the public utility in the official newspaper

(2) The Declaration of Transferability

The declaration of transferability is announced by Decree (Decree of Transferability)

This decree designates the real right of the buildings and the properties on which expropriation is applicable.

Law 76 advocates two possibilities in case of expropriation for public utility. Those are amicable transfer and judicial transfer.

- Publicizing of the transferability decrees in the official newspaper.
- Notification of the Decree to the concerned owners and fixing the date for the inventory of fixtures through a recommended letter including acknowledgement of receipt.
- Inventory of fixtures.
- Registration of transferability decree.
- Estimation of compensation to be proposed.

a) Amicable Agreement

After a 15 days dead-line starting from the publicizing in the official newspaper and the notification of transferability decree, the concerned owners are convened by the conciliation committee through a recommendation letter with acknowledgement of receipt.

In case of agreement during the conciliation meeting, the compensation of expropriation will be paid and the transfer is registered under the government unit that takes possession of the building.

- In case of agreement during the conciliation meeting, the expropriation compensation is paid.
- Registration of the property transfer under the name of the government.
- Taking possession of the building.

b) Judicial Transfer

- If there is no agreement, a summon is given to the concerned owners that they should appear before the judge in charge of expropriations (higher authority court of justice) in three months deadline starting from conciliation committee's meeting.
- The notice of expropriation is taken by the judge.
- Payment or consignment of provisional compensation.
- The notice of decision on the final amount of compensation.
- The payment of final compensation or consignment of complementary compensation.
- Property transfer registration under the name of the State.

However, in case of emergency, a decree is issued after the interview and approvals from the committee in charge of land operations control, which will declare the public utility operation is urgent, then designate the buildings required by the project realization and authorize the construction company to take possession of the concerned buildings.

A Committee on Maintenance Expenditures will evaluate the compensation to be given to the expropriated people as stipulated by prefectural law. The Committee is chaired by the prefect and includes various devoted governmental technical services.

7.3. The State and Private Land Attainment Plan

According to CADASTRE in Kaolack (Domain Office), there are two types of land expropriation proceedings (the State and Private) as summarized in the **Table 7.3.**.

Table 7.3.1 Two Types of Land Expropriation Proceedings

	State Land	Private Land
Land Price	The State land price is decided by the Presidential Decree in 2010. Basically, standard price of the State land is 3,000 to 25,000 FCFA/$m^{2.}$ (Land Price=Standard price per square meter)	1) Private land price is decided by the market, which includes the other properties' price such as buildings. 2) The price is evaluated and fixed by CADASTRE and Urbanism Office in Kaolack Region. 3) Presidential decree must be issued for land expropriation. 4) In this case, the compensation is paid with money.
Process	1) Project promoters submit the request letter for land expropriation to CADASTRE Regional Office in Kaolack. 2) CADASTRE Regional Office in Kaolack submits a letter to the Headquarters of CADASTRE (Domain Department) in Dakar. 3) The Headquarters of CADASTRE decides to approve the request. When the request is approved, the land is allocated to the project.	1) Project promoters submit the request letter for land expropriation to CADASTRE Regional Office in Kaolack. 2) CADASTRE Regional Office in Kaolack submits a letter to the Headquarters CADASTRE (Domain Department) in Dakar. 3) CADASTRE Headquarters submit the request letter to the President, and the President organizes a committee for land expropriation. When the committee approves the request, a Presidential Decree is issued for the land expropriation.
In case of Disagreement	-	1) Although land owners have the right to claim legal judgment against the land expropriation process, land can be expropriated by force under a Presidential Decree. However, project promoter/implementing organization must transfer compensation (money) into the bank accounts of the land owners.

8. Environmental Checklist

As shown the following table, JICA's Environmental Check-list was used to assess various aspects of the environmental and social consideration of the Project.

Table 8.1.1 Environmental Check List

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) Y (c) N (d) -	(a) EIA Report is prepared in the authorized manner and is to be approved in January 2014. (b) TOR of the EIA study was approved, and Technical committee for validation of the EIA report was held on 26th of September 2013, and validated with conditions (SEA report for the Master Plan of the Project was approved by the DEEC/DREEC in 2012). Approval letter will be issued in January 2014. (c) - (d) -
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) Stakeholder meeting with local people was held in the EIA study. (b) Project report reflects the comments from local people and propose plan such as alternative of simplified sanitation system in Koundam District.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Alternative plan such as simplified sanitation system in Koundam District was examined in the EIA report.
2 Pollution Control	(1) Water Quality	(a) Do pollutants, such as SS, BOD_5, COD_{Cr}, pH contained in treated effluent from a sewage treatment plant comply with the country's effluent standards? (b) Does untreated water contain heavy metals?	(a) Y (b) N	(a) Effluent standards of SS, BOD_5 and COD_{Cr} are not complied; therefore improvements of sewage treatment plant are proposed in the project. (b) There is no report that heavy metals are included in untreated water.
	(2) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) ONAS properly manages the sludge generated in the operation of sewage treatment plan in accordance with the Environmental Code in Senegal.
	(3) Soil Contamination	(a) If wastes, such as sludge are suspected to contain heavy metals, are adequate measures taken to prevent contamination of soil and groundwater by leachates from the wastes?	(a) -	(a) Sewage in Kaolack consists of domestic and commercial wastewater; therefore sludge generated from the STP contains no heavy metals.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as sludge treatment facilities and pumping stations comply with the country's standards?	(a) Y	(a) Proposed facilities in the STP and pumping stations in the project will be operated in order to comply with Environmental Code in Senegal.
	(5) Odor	(a) Are adequate control measures taken for odor sources, such as sludge treatment facilities?	(a) Y	(a) Mitigation measures such as planting trees on the boundary of STP is proposed in the project and also layout plan of each facility minimizes diffusion of odor.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There are no protected areas designated by Senegalese laws and international treaties and conventions around the Project sites. However, Kaolack City Hall has a plan to establish protected beach in Koundam district.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a) N (b) N (c) - (d) -	(a) No primeval forests, tropical rain forests, ecologically valuable habitats are found in and around the project sites. (b) No the protected habitats of endangered species are found in and around the project sites. (c) No significant ecological impacts are predicted in the project. (d) The project will not affect aquatic environment but rather the aquatic environment will be improved by installing sewage facilities.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) - (c) - (d) - (e) - (f) - (g) - (h) - (i) - (j) -	(a) The project includes no resettlement. Land acquisition will be executed in accordance with Senegalese Law No.76-67 and Environmental Code. (b) - (c) - (d) - (e) - (f) - (g) - (h) - (i) - (j) -

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Living and Livelihood	(a) Is there a possibility that changes in land uses and water uses due to the project will adversely affect the living conditions of inhabitants? (b) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a) N (b) N	(a) All the facilities such as STP, pumping stations and reservoir in the project, are planned not to affect land uses and water uses of the inhabitants. (b) There is no possibility to affect the living conditions of inhabitants but dredging of downstream end of drainage pumping station in Dialegne II district will be required by Kaolack City.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) No damage is given by the implementation of the project components.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) Proposed facilities in the project will be laid out not to affect scenery and sunshine of surrounding area of the facilities.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to lands and resources respected?	(a) - (b) -	(a) No ethnic minorities or indigenous peoples live in and around the project site. (b) Not applicable due to the above reason.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d) Y	(a) The project will be implemented in compliance with relevant laws and ordinances, which associated with labor, safety and health. (b) Safety countermeasures such as installation of safety equipment to prevent labor accidents and management of toxic subsistence are planned in the project. And also safety equipment such as masks, goggles, and boots are provided for workers. (c) Continuous awareness, safety and health trainings for worker will be conducted. (d) The project will provide appropriate education to security guards not to violate safety of other individuals and/or local residents.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Y (b) N (c) N (d) Y	(a) Construction equipment of low-noise and/or low-vibration type will be selected as far as practicable. And water sprinkling is conducted not to scatter dust during excavation works. (b) No significant impact to natural environment is predicted. (c) No significant impact to social environment is predicted. (d) Sign board and/or diversion road and so forth are set up to prevent traffic congestion in and around project sites.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d) Y	(a) EIA report proposed the monitoring plan. (b) Monitoring items, methods and frequencies, are stipulated in the monitoring plan of EIA report. (c) Monitoring frameworks are established in the Feasibility Study report. (d) Regulatory requirements are identified in the monitoring frameworks.
6 Note	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	(a) Emission of methane will be reduced by expansion of sewered area since the amount of wastewater properly treated increases.

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.