

PERFORMANCE AUDIT REPORT ON
PROVISION OF SEWERAGE IN MAJOR TOWNS
IN KENYA:
A CASE STUDY OF NAIROBI CITY



ATHI WATER SERVICES BOARD

APRIL 2018

Vision

Effective accountability in the management of public resources and service delivery

Mission

Audit and report to stakeholders on the fairness, effectiveness and lawfulness in the management of public resources for the benefit of the Kenyan People

Core Values

Independence

Integrity

Professionalism

Innovation

Team Spirit

Motto

Enhancing Accountability

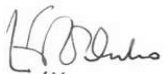
Foreword by the Auditor – General

I have the honour to present this performance audit report which assessed the provision of sewerage infrastructure in the major towns of Kenya. My Office carried out the audit under the mandate conferred to me by the Public Audit Act, 2015 Section 36. The Act mandates the Office of the Auditor – General to examine the Economy, Efficiency and Effectiveness with which public money has been expended pursuant to Article 229 of the Constitution.

Performance, financial and continuous audits form the three pillar audit assurance framework that I have established to give focus to the varied and wide scope of the audit work done by my office. The framework is intended to provide a high level of assurance to stakeholders that public resources are not only correctly disbursed, recorded and accounted for, but that the use of resources results in positive impacts on the lives of all Kenyans. The main goal of our performance audits is to ensure effective use of public resources and promote services delivery to Kenyans.

The audit has an environmental management perspective on the importance of conserving of water resources. Our performance audits examine compliance with policies, obligations, laws, regulations and standards, and whether the resources are managed in a sustainable manner. They also examine the economy, efficiency and effectiveness with which public resources have been expended. I am hopeful that corrective action will be taken in line with our recommendations in the report. The recommendations will contribute towards the realization of the provisions of Articles 42, 69, 70 and 71 of our Constitution, which call for better management of the environment for the benefit of all Kenyans.

The report shall be tabled in Parliament in accordance with Article 229 (7) of the Constitution. I have as required in Section 39 (1) of the Public Audit Act, submitted the original copy of the report to Parliament. In addition, I have remitted copies of the report to the Cabinet Secretary Ministry of Water and Sanitation, Principal Secretary, National Treasury, Chief Executive Officer, Athi Water Service Board and the Secretary, Presidential Delivery Unit.



FCPA Edward R.O. Ouko, CBS
AUDITOR – GENERAL
11 April 2018

LIST OF ABBREVIATIONS

ADB	African Development Bank
BOD	Biological Oxygen Demand
AWSB	Athi Water Services Board
CBOs	Community Based Organisation
COD	Chemical Oxygen Demand
DEWWTP	Dandora Estate Waste Water Treatment Plant
EMCA	Environmental Management and Coordination Act
KeNHA	Kenya National Highways Authority
MWI	Ministry of Water and Irrigation
NaRSIP	Nairobi Rivers Sewerage Improvement Project
NCWSC	Nairobi City Water and Sewerage Company
NEMA	National Environment Management Authority
SPA	Service Provision Agreement
TSS	Total Suspended Solids
WAB	Water Appeal Board
WASREB	Water Services Regulatory Board
WRMA	Water Resources Management Authority
WSB	Water Services Boards
WSP	Water Services Providers
WSTF	Water Services Trust Fund

TABLE OF CONTENTS

List of Figures.....	iii
List of Tables	iii
List of Pictures	iii
Glossary of Terms.....	iv
EXECUTIVE SUMMARY	V
CHAPTER 1: BACKGROUND OF THE AUDIT.....	1
Introduction.....	1
Motivation for the Audit.....	1
CHAPTER 2: DESIGN OF THE AUDIT	2
Audit Questions.....	2
Scope of the Audit	2
Sources of Assessment Criteria	2
Methods Used to Gather Evidence	2
Sampling and Sample Size	2
CHAPTER 3: DESCRIPTION OF THE AUDIT AREA	4
Institutional Framework for the Provision of Sewerage in Kenya.....	4
Key Actors in the Provision of Water and Sewerage Services	5
Athi Water Services Board(AWSB).....	6
Process Description.....	6
Funding for Athi Water Service Board	9
CHAPTER 4: AUDIT FINDINGS	11
Inadequate Identification of Sewerage Needs.....	11
Delays in implementation of sewerage projects	13
Some of the Sewerage facilities developed by AWSB are based on inappropriate technology, making them uneconomical to operate.....	17
The existing sewerage has not been well maintained	17
CHAPTER 5: CONCLUSION	21

CHAPTER 6: RECOMMENDATIONS22

APPENDICES23

Appendix 1: Methods of gathering evidence 23

Appendix 2: AWSB Organizational Structure..... 24

Appendix 3: Breakdown of Sewers Developed by AWSB 25

Appendix 4 - Response of the Chief Executive Officer on the Audit Findings 26

LIST OF FIGURES

Figure 1: Institutional Framework under the Water Act 2002.....	4
Figure 2: Sewerage System.....	7
Figure 3: Description of the Process for Developing Sewerage	7

LIST OF TABLES

Table 1: Expenditure on sewerage by AWSB under various projects	10
Table 2: Sewerage projects implemented in Nairobi during the period 2010/11-2014/15.....	11
Table 3: Sewer networks developed by AWSB during the period 2011/12-2014/15	13
Table 4: Delays in completion of projects	14
Table 5: Compliance of Kariobangi W.W.T Plant during the Period July 2011 to June 2015	19

LIST OF PICTURES

Plate 1: Littered pond in Dandora Estate Waste Water Treatment Plant	13
Plate 2: Incomplete section of Sewer Blue Estate, Nairobi.....	15
Plate 3: An Overflowing Manhole Near Museum Hill Round About along Nairobi River	18
Plate 4: Physical appearance of water at Dandora ponds outlet terrace	19
Plate 5: Human encroachment into Kariobangi Waste Water Treatment Plant	20

GLOSSARY OF TERMS

The following definitions apply for purposes of this report:

Appropriate Technology: Technology that is suitable to the economic conditions of the area in which it is to be applied, is environmentally sound, and promotes self-reliance on the part of those using it.

Major town: A town whose population, according to the 2009 National Population and Housing Census report, is not less than 250, 000.

Riparian reserve: Land adjacent to and associated with a watercourse. Riverine riparian reserve refers to riparian reserve along rivers and streams

Sewage: Water-carried waste, in solution or suspension, that is intended to be removed from a community

Sewer: An underground carriage system specifically for transporting sewage from houses and commercial buildings to treatment plant

Sewerage: The infrastructure that conveys sewage and consist of sewers, manholes, pump stations and treatment plants

Wayleave: A right of way created on a public land for the purposes of laying of fuel pipe lines, water mains, sewer lines, power lines and communication lines

Executive Summary

Background to the Audit

1. Provision of sewerage services in Kenya dates back to the colonial period, the time during which most sewerage, currently in use were designed and developed. The provision of sewerage services has been, however, characterized by such challenges as lack of a legal framework, disjointed and overlapping policies, old and inadequate infrastructure, lack of connection networks and poor performance of utilities. Further, the capacity of sewerage service provision has been stretched by rapid population growth and urbanization. Consequently, concerns about sewage flooding, sewer bursts and the discharge of raw or semi-treated sewage into the environment have made news in the recent past. Due to these concerns the Auditor-General decided to assess the measures put in place to provide sewerage in major towns.
2. According to the Water Act, 2002, provision of sewerage services is the responsibility of Water Service Boards (WSBs). The Act, however, allows the WSBs to subcontract Water Service Providers (WSPs) through Service Provision Agreements to do the actual service delivery, while the boards remain responsible for the development of the sewerage.

Objective of the Audit

3. The objective of the audit was to assess the measures put in place by AWSB to provide sewerage in Nairobi city.

Scope of the Audit

4. The audit focused on the provisions of sewerage services in Nairobi by AWSB. The operations of AWSB was examined with respect to development of new and; rehabilitation and maintenance of the existing infrastructure. Nairobi was considered appropriate in this study since it has major sewerage development projects being implemented. The audit covered five years, from July 2010 to June 2015.

5. Audit evidence was gathered through interviewing concerned actors, reviewing documents and direct observations (including taking photographs).

Major Findings

Inadequate identification of sewerage needs

6. While investment in sewerage is expected to offer the best solution in meeting sewerage needs of the concerned towns, the audit revealed that sewerage needs identification as conducted by WSBs was faced with certain problems.
7. AWSB did not provide needs assessment documents for sewerage projects recently implemented in Nairobi. Enquiries revealed that the boards based the projects on the recommendations of previous studies, some of which were already overtaken by recent events. For example, AWSB based the projects on the recommendations of the 1998 Nairobi Master Plan for Sewer, Sanitation and Drainage.
8. Further, it would be expected that WSPs would be actively involved during planning for sewerage projects since as users of the infrastructure they are better placed to pinpoint the service gaps. Interview with NCWSC staff revealed they were involved in the planning stages of the project, though to a limited extent.
9. As a result of the inadequate needs identification, some of the sewerage developed by the boards do not address the current sewerage service provision needs in the concerned towns. For example, by implementing three projects, i.e. Nairobi Sewerage Improvement Project (NaRSIP), Mukuru and Gatharaini sewers, AWSB delivered 84.1 Km of trunk sewers, but only 66.9 Km of reticulation sewers yet it is the latter that is actually required to connect households to the sewer system. Lot III of NaRSIP, for instance, delivered 15.5 Km of trunk sewers to cover Dandora Estate Waste Water Treatment Plant (DEWWTP), Kangundo Road, Kibera, Upper Hill, and Kirichwa Dogo areas, but only 1.2 Km of reticulation sewers.
10. Residents of the affected estates will therefore have

to wait before they can enjoy sewerage services despite trunk sewers passing within their vicinity. The achievement of Nairobi Rivers Basin Rehabilitation and Restoration Programme's objective of enhancing environmental quality will continue to remain elusive so long as the reticulation sewers are not developed.

11. The inadequate identification of sewerage needs was attributed to dependence on the implementation of recommendations of broad long term studies and plans to some extent and the apparent friction in the working relationship between WSBs and WSPs following the devolution of water services. Staff of both AWSB interviewed also blamed donor influence on the scope of projects as the donors at times have a pre-determined scope hence no need for needs identification.

Delays in implementation of sewerage projects

12. Sewerage development usually takes the form of capital works project with specific start and end dates documented in the project document. WSBs are expected to follow project implementation dates closely since implementation delays can have serious implications on the project being implemented.
13. The audit revealed that sewerage rehabilitation and expansion projects undertaken by AWSBs have taken longer than their planned completion dates. A review of project implementation reports for three projects in Nairobi (NaRSIP, Mukuru and Gatharaini) revealed that none was delivered within the planned project implementation dates. The NWSEPIP 4a-Mukuru Sewers Project was planned to take 12 months. However, the project started in March, 2011 and was completed in July 2014, recording a delay of about 27 months. Further, NaRSIP Lot IV was expected to be completed by February 2016, but the project was only 27% complete as at January, 2016.
14. The delays led to cost escalations and significant reductions in project scope. For example, the NWSEPIP 4a-Mukuru Sewers recorded a cost overrun of 7.708% from the initial cost of Ksh. 155,028, 834.40 to Ksh. 166,978,895 at completion. Besides, the delays

meant that the environment continued to be polluted awaiting completion of the sewerage projects. The condition could even get worse, for example in a situation where raw sewage is diverted into a river to allow for rehabilitation of the existing infrastructure.

15. The implementation delays were attributed to several factors. The audit team was informed that most of the way leaves in Nairobi had been encroached. While AWSB ought to have acquired wayleaves before commencing project implementation, this was left to run concurrently with implementation hence slowing down the projects. At times, AWSB was forced to redesign certain aspects of the projects when wayleave acquisition efforts proved futile. For example, NaRSIP Lot I (Kiu River and Dandora Trunk Sewers) was redesigned to include a pump station after realizing that the land where some of the ponds were to be constructed was already encroached.
16. Again, interviews and review of documents revealed that implementation delays were also caused by inadequate performance of contractors. For example, NaRSIP Lot I was partly delayed by the contractor's delay in construction of part of Riara trunk sewers. Further, NaRSIP Lot IV had also been delayed by the contractor's failure to bring equipment to site in time.

Some of the sewerage facilities developed by AWSB are based on inappropriate technology, making them uneconomical to operate

17. While WSBs are expected to deliver sewerage which is economical to operate and maintain in accordance with Section 53 (1) of the Water Act (2002), the audit revealed that some of the sewerage facilities developed by AWSBs are based on technology that is not appropriate for Kenya. Though very efficient in treating waste water, the electromechanical treatment plants are energy intensive and are often abandoned by the WSPs due to high operation and maintenance costs.
18. Interviews, document reviews and field verifications revealed that AWSB recently rehabilitated the mechanized sewerage treatment plants in Nairobi.

Due to the energy intensive nature of these plants and the high maintenance costs and sometimes non-availability of spare parts in the local market, NCWSC abandoned these plants leading to the extremely dilapidated state they were in before the recent rehabilitation works commenced. Although the rehabilitation will definitely improve their waste water treatment efficiency, these plants may still fail to achieve their intended purpose due to the high cost of operation and maintenance involved.

19. Further, AWSB has constructed an energy intensive pump station just within DEWWTP, despite NCWSC opposing its construction. Interviews with both AWSB and NCWSC revealed that the defunct City Council of Nairobi decommissioned most of the pump stations in 1982 due to the high operation and maintenance costs involved.
20. Consequently, these facilities may become expensive for WSPs to operate and maintain and may just be abandoned. For instance, an investment intended to mechanize the collection of trash at DEWWTP inlet works failed only a year after it was handed over to NCWSC. The machine broke down in 2010 and has not been repaired, as NCWSC considered its maintenance costs too high. As the facilities are abandoned, the environment will continue to be polluted with partially treated effluents from treatment plants or raw sewage from pump stations flowing to the environment.
21. The use of inappropriate technology may be attributed to the failure to take advantage of local opportunities for resources and materials during planning and design of sewerage projects. Again, since WSBs are only responsible for the development of sewerage while operation and maintenance lies with WSPs; WSBs might have overlooked the operation and maintenance cost implications of these facilities.

The existing sewerage has not been well maintained

22. According to section 53 (1) of the Water Act, 2002, WSBs are responsible for the efficient and economical provision of water within their area of

jurisdiction. Arising from this mandate, WSBs are not only expected to plan, develop and expand sewerage in accordance with Section 53 (3) (a), but also ensure that the existing infrastructure is well maintained in accordance with Section 55 of the Water Act, 2002.

23. According to the Service Provision Agreement (SPA), when there is a maintenance issue the NCWSC is required to notify AWSB and make a financial quotation for the same. The NCWSC is then expected to go ahead and repair then bill the AWSB. In cases where NCWSC is unable to perform, it is expected to inform AWSB to take action.
24. Although the SPA appears to fully delegate repairs and maintenance to the NCWSC, it would ordinarily be expected that as owners of the assets, AWSB must take action to save the situation where it has been shown that the NCWSC is unable to carry out the repair or maintenance.
25. The audit revealed that the sewerage has not been well maintained in Nairobi. Field observations revealed various instances of burst sewers, open and overflowing manholes and blocked sewers within Nairobi. As a result, the environment is polluted with raw sewage. The open manholes are at times used as dumping ground for solid waste by the public, hence causing blockages in the system. This poses a risk to the environment and health of the community at large.
26. Further, the audit revealed inadequate maintenance of sewerage treatment plant in Nairobi. A visit to DEWWTP revealed that the inlet works had broken down in 2010 and has not been repaired since then. The trash crusher also broke down in 2013 and no repairs have been done to date. As a result, much of the solid waste and plastics, which is intended to be trapped by the machines escape into the ponds thereby reducing the plant's treatment efficiency.
27. As a result of inadequate maintenance of sewerage, the treated sewage being discharged back to the environment do not meet NEMA recommended quality standards as measured by Biological Oxygen

Demand (BOD), Chemical Oxygen Demand (COD) and Total Suspended Solids (TSS).

28. The inadequate maintenance of sewerage was attributed to the confusion that exists with regard to the application of Item 10 of SPA that delegates repairs and maintenance to NCWSC without clearly specifying the responsibilities with respect to the nature and extent of repairs required.
29. Further, the audit team was informed that WSPs no longer report to WSB regularly about their operations following the devolution of water services as contained in Schedule 4 Part 2(11) of the Constitution of Kenya, 2010. As such, WSBs are not able to keep track of the maintenance activities being undertaken by WSPs.
30. The problem is further compounded by the fact that WSBs do not undertake routine monitoring of the sewerage as the owners of the asset. AWSB failed to provide evidence that they monitor or inspect the status of sewerage system as the custodians of the infrastructure. As a result, AWSB are not aware of maintenance needs of sewerage in Nairobi. Besides, lack of monitoring of sewerage has led to encroachment into sewerage facilities, wayleaves and land for sewerage; further hampering maintenance of the infrastructure.

Conclusion

31. From the findings of the audit it is clear that AWSB has made some efforts to provide sewerage services in Nairobi since its establishment following the enactment of Water Act, 2002. However, these efforts have not resulted in an adequate sewerage in the concerned towns. The sewerage development projects implemented by the AWSB have shortcomings emanating from inadequate needs identification, use of inappropriate technology and delays in project implementation. In addition to that, the already developed infrastructure has been inadequately maintained further contributing to inadequacy of the sewerage system. More specific conclusions were made as follows:

- i) AWSB failed to treat needs assessment as an integral component of sewerage development. The board instead relied on recommendations of a long term baseline master plan which led to the implementation of projects that do not address the current sewerage needs of users in Nairobi.
- ii) The appropriateness of technology is key to sustainability of sewerage. While the mechanized treatment plants and pump stations developed and rehabilitated in Nairobi look very efficient, the high operation and maintenance costs involved in such facilities poses a risk to their economical sustainability under the operation of NCWSC.
- iii) Due to wayleave acquisition challenges and encroachment of land, the implementation of sewerage projects in Nairobi recorded significant delays. This led to significant reduction in project scope or cost overruns.
- iv) Due to the failure of AWSB to monitor the condition of sewerage infrastructure handed over to NCWSC, the existing sewerage has not been well maintained as was evidenced by an inadequately maintained sewerage system in Nairobi.

Recommendations

32. The Auditor-General made the following recommendations to improve on the provision of sewerage in Nairobi:
 - To ensure that sewerage projects meet the current needs of Nairobi:-
 - AWSB may consider putting more emphasis on identification of current sewerage needs when planning for sewerage projects. The boards should consider undertaking baseline studies when planning for sewerage projects to bring the current situation on board in addition to relying on recommendations from the previous studies. The WSPs and users of the sewerage need also be actively involved during needs assessment and their input

considered when making the final decision.

- To address delays during implementation of sewerage projects:-
 - AWSB may consider acquiring wayleaves before commencing actual implementation of sewerage projects
 - AWSB may need to ensure that contractors are suitably evaluated and strictly adhere to contract terms of references including project implementation timelines.
- To ensure that the resultant sewerage facilities are cost effective:-
 - AWSB may need to ensure that the mechanized systems are based on appropriate technologies by putting local opportunities for resources and materials into consideration when designing, developing and implementing the systems.
- To ensure that the existing sewerage is well maintained:-
 - AWSB may need to develop mechanisms to ensure regular reporting of WSPs operations as provided for in the Service Provision Agreements
 - As Owners, AWSB should regularly monitor the status of sewerage infrastructure and ensure its maintenance.

Chapter 1

1.0 Background of the Audit

Introduction

- 1.1 Appropriate sanitation is fundamental not only in promoting public health, but also in ensuring environmental sustainability. Consequently, sewerage services play an important role of protecting public health through proper sanitation standards that prevent the transmission and spread of water borne diseases such as diarrhea and cholera. It also protects the environment through nutrient recycling as well as preventing surface and underground water contamination.
- 1.2 According to WASREB's Model Water Services Regulations, sewerage consists of structures, pipes, valves, meters, sewers or other accessories used in the conveyance through the sewer reticulation (connection) system and treatment at the treatment plant. .
- 1.3 Provision of sewerage services in Kenya dates back to the colonial period, the time during which most sewerage, currently in use, were designed and developed. The provision of sewerage services has been, however, characterized by such challenges as lack of a legal framework, disjointed and overlapping policies, old and inadequate infrastructure, lack of connection networks and the poor performance of utilities. Further, the capacity of sewerage service provision has been stretched by rapid population growth and urbanization that has affected major towns.
- 1.4 According to the Water Act, 2002, provision of sewerage services is the responsibility of Water Service Boards (WSBs). The Act, however, allows the WSBs to subcontract Water Service Providers (WSPs) through Service Provision Agreements to do the actual service delivery, while the boards remain responsible for the development of the sewerage used by WSPs.
- 1.5 There have been public concerns about the poor state of sewerage services in most towns across the country. Concerns of sewage flooding, sewer bursts and the discharge of raw or semi-treated sewage into the environment have made news in the recent past. The Auditor-General therefore finds it necessary to assess the provision of sewerage in major towns in Kenya.
- 1.6 In a bid to address sewerage problems in Kenyan urban areas, the government has undertaken a number of capital intensive sewerage projects in some of the major towns. For example, the Nairobi Rivers Sewerage Improvement Project (NaRSIP) is a loan project from Africa Development Bank (AFD) amounting to USD 54,608,050. It is therefore necessary to assess the effectiveness of these projects in ensuring an adequate sewerage.
- 1.7 According to a report published by UNEP and UN-Habitat in 2010 titled Sick Water?, up to 90% of the waste water generated worldwide flows untreated into the densely populated coastal zones contributing to marine dead zones. The report further states that at least 1.8 million children under the age of five worldwide die annually due to water related diseases. The sanitation situation is worse in developing countries. In Sub-Saharan Africa, for instance, only 30% of the population have access to improved sanitation, according to the 2015 Millennium Development Goals (MDG) Report for Africa. In Kenya, only 16% of Kenyans have access to sewerage services, down from 17%, according to the WASREB 2013-14 Impact Report. The remaining population either use septic tanks, pit latrines or just discharge raw sewage into the environment.
- 1.8 The poor, or lack of, management of waste water leads to pollution of the already scarce water resources further complicating the challenge of providing safe drinking water to the world's population with either no or constrained access to the same. There is therefore the need to undertake a performance audit to assess the measures in place to expand sewerage systems to cover the majority of Kenyans living in major towns.

Motivation for the Audit

Chapter 2

2.0 Design of the Audit

Objective of the Audit

- 2.1 To assess the adequacy of measures put in place by AWSB to provide sewerage in Nairobi City.

Audit Questions

- 2.2 The following were the questions that we answered so as to achieve the objectives of the audit:

Overall question: Are the measures put in place by AWSB effective in providing sewerage?

Sub-questions:

- i) Does the planning for sewerage focus on addressing the adequacy of sewerage needs of Nairobi?
- ii) How does AWSB ensure the timely implementation of planned development and execution of sewerage projects?
- iii) How does AWSB ensure that projects infrastructure developed are appropriate and economical to implement?
- iv) How does AWSB maintain the existing sewerage infrastructure?

Scope of the Audit

- 2.3 The audit focused on the provision of sewerage in Nairobi by AWSB. The operations of Athi Water Services Board was examined with respect to development of new and, rehabilitation and maintenance of the existing infrastructure. Nairobi was considered appropriate in this study since it has major sewerage development projects being implemented. The audit focused on the period of five years, from July 2010 to June 2015.

Sources of Assessment Criteria

- 2.4 The audit criteria that was used in assessing the AWSB was obtained from the Water Act, 2002, Environmental Management and Coordination Act, (Water Quality) Regulations, National Water Services Strategy 2007-2015, License documents for the Water

Service Boards, Nairobi Water Master Plan-2012, current Strategic Plan, contract documents, financial reports/budgets and WASREB performance review reports. Other than the documents, other criteria were obtained from leading practices.

Methods Used to Gather Evidence

- 2.5 The audit was conducted in accordance with Performance Auditing Guidelines set by the International Organization of Supreme Audit Institutions (INTOSAI) and audit policies and procedures established by the Office of the Auditor-General (OAG).

Sampling and Sample Size

- 2.6 The team used a case study approach in the audit. Purposive sampling was used to obtain two out of the five identified major towns to form case studies for the audit. Major towns as used in this audit included the three cities (Nairobi, Mombasa and Kisumu) and any other town whose population, according to the 2009 census qualifies it for the status of a municipality. According to the Urban Areas and Cities Act, 2011, a town is eligible for conferment of Municipal status if it has “a population of at least two hundred and fifty thousand residents, according to the final gazetted results of the last population census carried out by an institution authorized under any written law, preceding the grant.” As such, only Nakuru and Eldoret with total populations of 286,411 and 252,061 respectively according to the 2009 Population and Housing Census report qualified to be considered as major towns giving a sample population of five major towns, namely; Nairobi, Mombasa, Kisumu, Nakuru and Eldoret.¹

- 2.7 The criteria used to purposively sample the two cases was that the town must at least have major sewerage development project either ongoing or completed, but started not earlier than June, 2010. As such Nairobi and Kisumu were selected to form case studies for the audit with each case being reported separately. It was believed that the two case studies were

¹ The 2009 Kenya Population and Housing data was obtained from the government's Open Data website (<https://www.opendata.go.ke/Population/Population-Distribution-by-Sex-in-Urban-Centres-an/yc6j-ekrh>). Accessed on 11th February 2016.

representative enough to give a clear understanding of the audit object.

2.8 The team used interviews to understand the operations of AWSB with regard to development of sewerage. The list of people interviewed is provided in **Appendix 1(a)**. Document review was used to obtain an understanding of the mandate, strategy, funding, regulations and procedures in providing sewerage as well as the status of sewerage projects implemented. The list of documents reviewed is provided in **Appendix 1(b)**. Observation was carried out to verify the actual status of sewerage development projects on the ground as well as the status of existing sewerage. The list of places visited is provided in **Appendix 1(c)**.

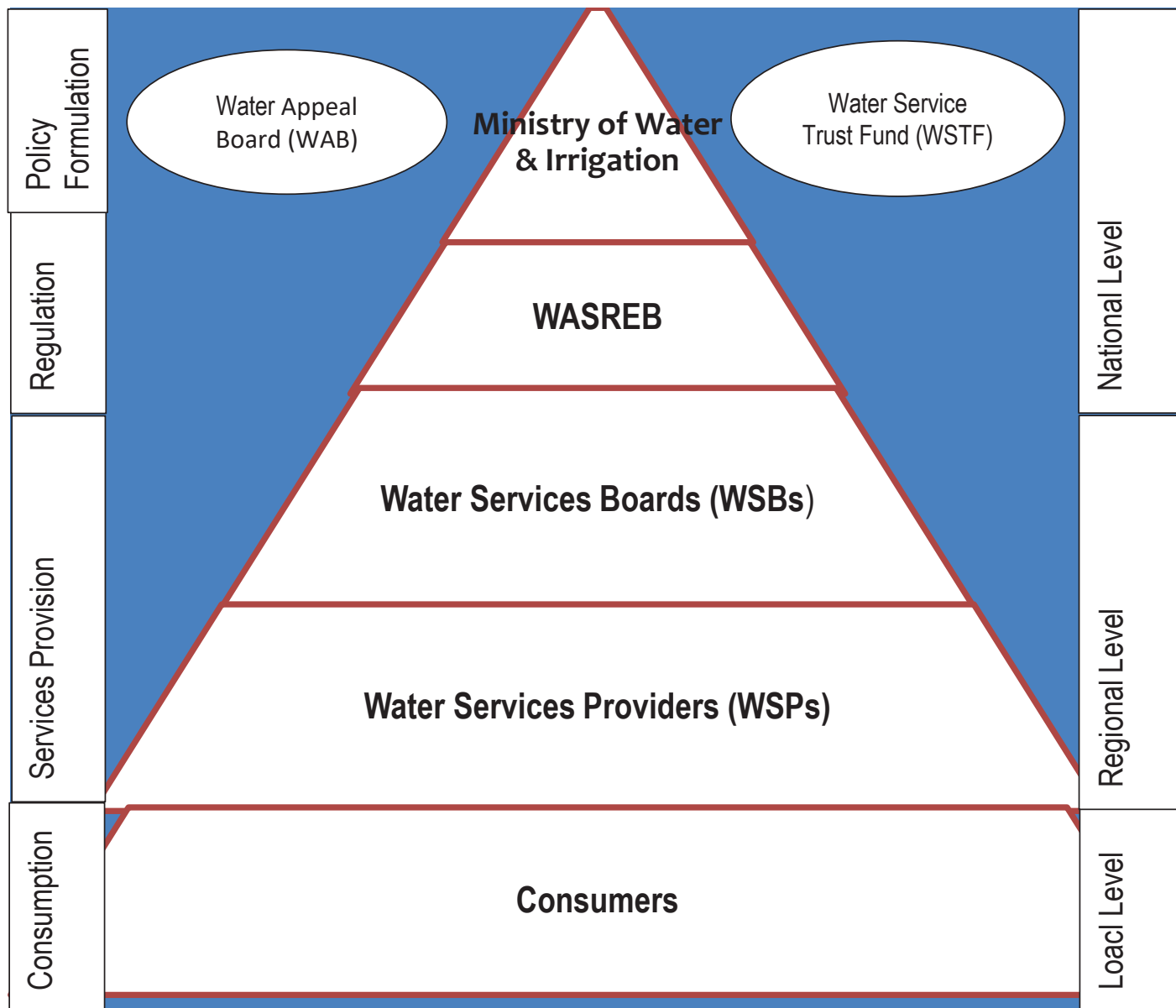
Chapter 3

3.0 Description of the Audit Area

Institutional Framework for the Provision of Sewerage in Kenya

3.1 The enactment of the Water Act, 2002 set the stage for far reaching reforms in the provision of water and sanitation services in Kenya. The Act introduced new water institutions to govern water and sanitation services in a commercialized and devolved approach. A schematic illustration of the institutional framework for water and sanitation services in Kenya is depicted in the Water Act, 2002 as shown in **Figure 1**.

Figure 1: Institutional Framework under the Water Act 2002



Source: National Water Services Strategy (2007-2015)

3.2 At the national level, the Ministry of Water and Irrigation (MWI) is responsible for policy formulation while the Water Services Regulatory Board (WASREB) is mandated with the regulation of water and sanitation services throughout the country. The Water Appeal Board (WAB) solves water services disputes while Water Service Trust Fund (WSTF) is responsible for funding water services in marginalized areas. WASREB licenses regional water services boards to provide water services within their jurisdictions. The boards in turn license water service providers to do actual water service delivery to consumers.

Key Actors in the Provision of Water and Sewerage Services

3.3 Provision of sewerage involves a number of stakeholders. The key stakeholders and their respective roles are:

Ministry of Water and Irrigation (MWI)

3.4 The Ministry of Water and Irrigation is responsible for policy formulation, resource mobilization, coordination and provision of technical standards for the provision of water services (water supply and sanitation services).

A. Water Services Regulatory Board (WASREB)

3.5 The WASREB is established under Section 46 of Water Act, 2002. It is mandated with the regulation of water and sanitation services throughout the country. It provides and enforces regulatory guidelines and quality standards for the water service provision. It also licenses regional Water Service Boards (WSBs) to provide water services within their jurisdictional regions. The WSBs in turn license water service providers to do actual water service delivery to consumers.

B. Water Services Boards (WSBs)

3.6 The responsibility for provision of sewerage services is vested on the various regional WSBs established under Section 51 of the Water Act, 2002. WSBs are state corporations under the

MWI responsible for the efficient and economical provision of water and sewerage services as stated in section 53(1) of the Act. In Kenya there are eight regional WSBs: Athi Water Services Board; Tana Water Services Board; Tanathi Water Services Board; Coast Water Services Board; Rift Valley Water Services Board; Lake Victoria North Water Services Board; Lake Victoria South Water Services Board; and Northern Water Services Board. Athi Water Services Board is responsible for provision of sewerage in Nairobi.

C. Water Service Providers (WSP)

3.7 The Water Services Boards do not provide services directly, but through contracted agents, known as Water Service Providers (WSP), established under Section 55 of the Water Act, 2002. The contract is in the form of a Service Provision Agreement issued to one or several water service providers in respect to the board's area of supply. The WSP are commercial based institutions registered under the Companies Act Cap 486. The WSP operate and maintain the water and sewerage facilities at the local level on behalf of the WSBs who remain the asset owners and are responsible for infrastructural development.

D. Water Services Trust Fund (WSTF)

3.8 The WSTF is established under Section 83 (1) of the Water Act, 2002. The objective of WSTF is to assist in financing the provision of water and sanitation services to areas without adequate services in Kenya.

E. Water Appeal Board (WAB)

3.9 The WAB is established under Section 84 of the Water Act, 2002 and is mandated with the settlement of disputes arising from suit of any person having a right or proprietary interest which is directly affected by a decision or order of the Authority, the Minister or the Regulatory Board concerning a permit or license under the Water Act, 2002.

F. Water Resources Management Authority (WRMA)

3.10 The WRMA is an authority established under Section 7(1) of the Water Act, 2002 and mandated with management of water resources in Kenya under Section 8 of the Act. WRMA enforces regulations and standards relating to water issues. One of the functions of WRMA is to regulate water infrastructure, use and effluent discharge.

G. National Environment Management Authority (NEMA)

3.11 NEMA is a statutory body which is supposed to supervise and coordinate other stakeholders in the provision of sewerage services by ensuring that every County Government or person operating a sewage system or owner or operator of any trade or industrial undertaking is issued with an effluent discharge license and is guided by the monitoring guide for discharge into the environment and maintain the standards set out by the Authority.

H. County Governments

3.12 The Constitution of Kenya provides for a devolved system of governance and creates county governments in Article 176 to bring services closer to the people. Functions such as water and sanitation services are devolved under the Fourth Schedule of the constitution.

Ati Water Services Board(AWSB)

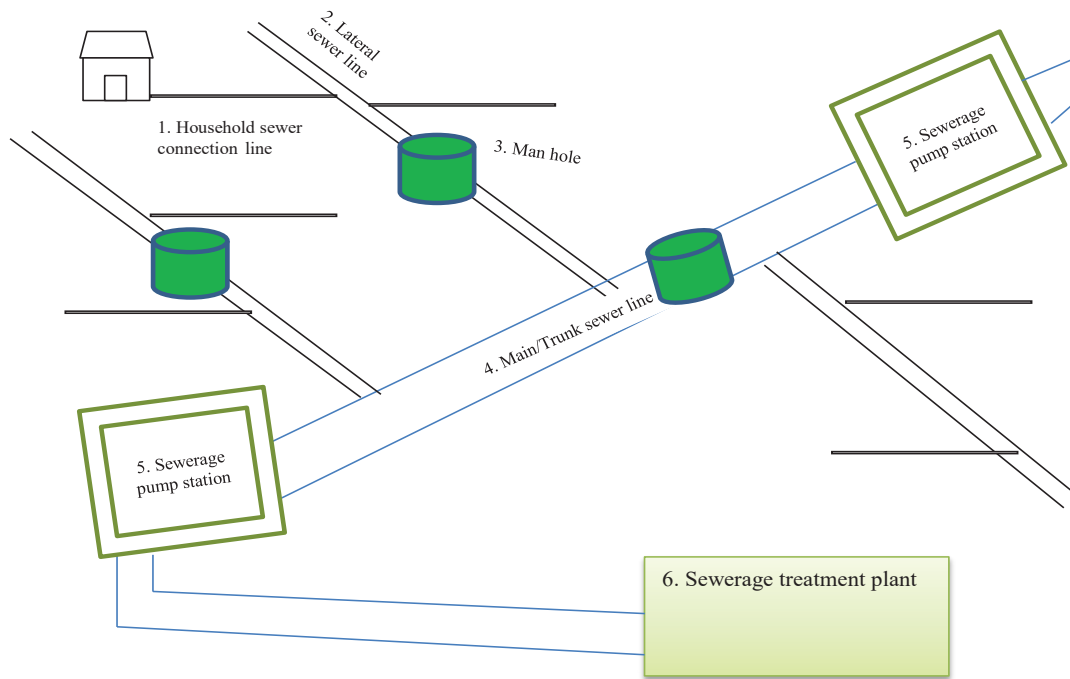
3.13 AWSB is headed by a Chief Executive Officer (CEO) who leads the management team in implementing the board's mandate. Under the CEO there are various departments as shown in **Appendix 2**. The responsibility for development of sewerage lies with the capital planning and engineering department which has three divisions:

- Development, planning and design
- Project management and implementation
- Transmission and asset management

Process Description

3.14 Sewerage system involves a network of sewerage connecting individual households to the treatment plant. Households are connected through household lines to reticulation/lateral sewers which then connect to trunk/main sewers. The trunk sewers deliver the collected sewage to treatment plant which then treat and discharge the treated effluent back to the environment. Along the laterals and trunk lines, manholes are strategically placed for inspection purposes. In areas where it is not possible to achieve gravity flow, pump stations are constructed to pump the sewage along the trunk sewers. A graphical illustration of the sewer system is provided in **Figure 2**.

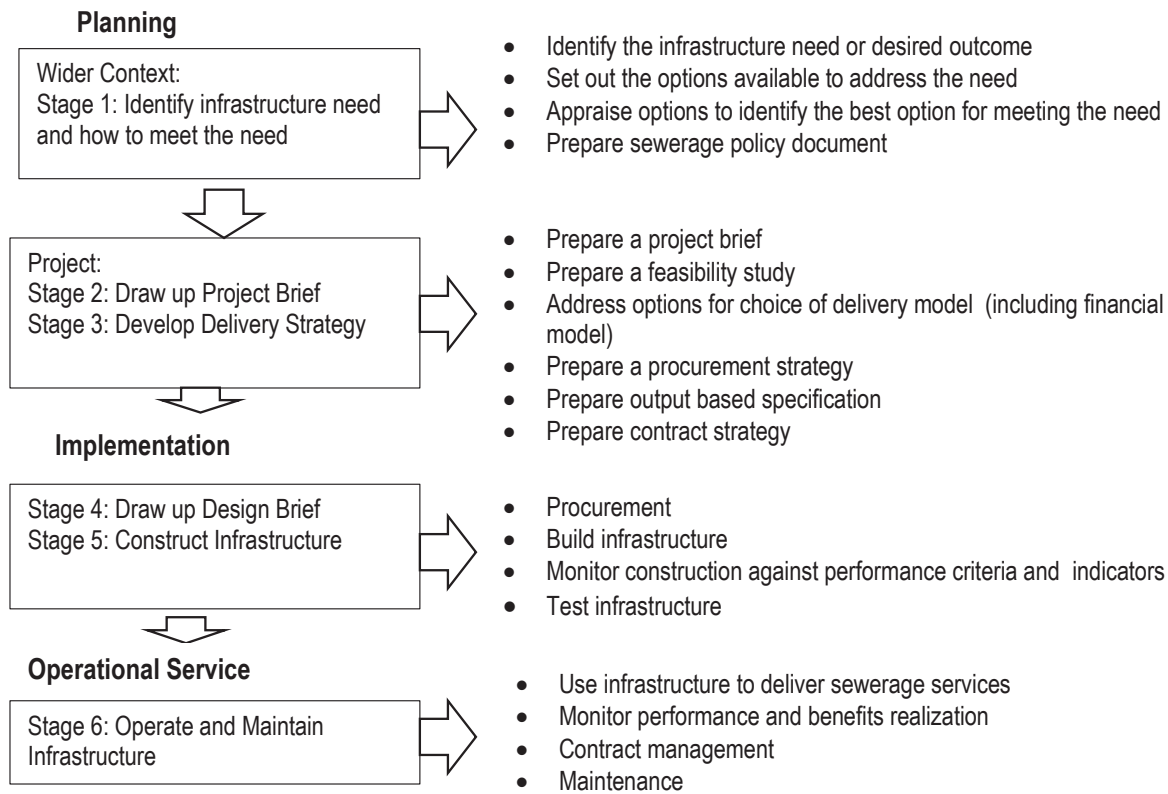
Figure 2: Sewerage System



Source: OAG Conceptualization, 2016

3.15 Generally, undertakings to develop sewerage system take the form of infrastructure development projects. Invariably sewerage development goes through six stages, which can be categorized into three steps, i.e. planning, implementation and operational service as shown in **Figure 3**.

Figure 3: Description of the Process for Developing Sewerage



Source: Adopted from INTOSAI-WGEA: *Environmental Issues Associated with Infrastructure*, 2013

a) Planning

- 3.16 The first step in sewerage development is to identify service needs. This is achieved through clarifying the current situation, including the current service level and demand met with the existing infrastructure; identifying current service gaps and assessing future service demands. The identification of service need is in a wider context and leads into sewerage policy statement. A policy need for sewerage development can arise where the current infrastructure lacks the capacity to meet current or future needs, a low service level and risk of infrastructure failing in the future.
- 3.17 Once the need for improvement in sewerage is identified, the various options to fulfil the need are then identified. The options may include: do nothing; improve output from existing infrastructure; upgrade existing infrastructure or develop new infrastructure. The options are then appraised so that the best is considered. These two steps culminate into a sewerage policy that guides the focus for development of sewerage. Sewerage needs identification in Kenya has been undertaken both at the national and local level. National sewerage development policy needs are documented both in the National Water Services Strategy (2007-2015) and the National Water Master Plan. Individual towns have also developed their own water services policy documents (action plans or master plans) highlighting sewerage development needs.
- 3.18 Guided by such policy documents, AWSB in consultation with WSPs develop a capital works plan, which is a ten-year plan for capital works, required to address the identified sewerage need. The capital works plan is accompanied by a business plan explaining how the identified capital works will be delivered.
- 3.19 Once, the sewerage needs are identified, the next step is to plan for specific projects. At this stage AWSB develop a project brief, which provides the basis for assessing whether the proposed project

is viable and achievable. The project brief is accompanied by a feasibility study of the project, which addresses the practicability of the project evaluated against alternative options based on expertise, costs and technological requirements.

- 3.20 Once the AWSB is convinced that the proposed project is the most viable, they then decide on a delivery model covering both financial and implementation strategies. Most sewerage projects in Kenya are donor funded, but options such as public-private partnership as well as entire government funding can also be explored. Potential donors are identified at this stage. An implementation strategy is developed to indicate whether the project will be implemented directly by AWSB or subcontracted to a contractor. Equally important to develop at this stage include the procurement strategy, contract strategy and output-based specifications.
- 3.21 The project planning stage culminates into a detailed project document that discusses among other issues background to sewerage need, preferred option, key stakeholders, expected outcomes and how they will be measured, budget and scope of the sewerage project, site analysis, likely impacts and how they will be mitigated, estimate of overall effort and who will do it; and an outline of required activities and key milestones

b) Implementation

- 3.22 Once the project planning phase is complete and funds availed for the proposed infrastructure project, the project proceeds to the implementation stage. Just like with any other infrastructure development project, the implementation stage is initiated by drawing up the design brief. The design brief is a preliminary design, which defines all design requirements for the infrastructure and is also the foundation on which the final design will be developed. It may include schematic drawings of the proposed infrastructure, general specifications of the infrastructure, the performance criteria once complete, site

information and any technical details which may affect the infrastructure development

3.23 The AWSB can engage the identified contractor to make any necessary adjustments on the design brief and develop detailed (final) design drawings with all information necessary to build a particular type of infrastructure. It shows what the finished infrastructure will look like, how materials and components will be integrated together; and the dimensions and layout of the sewerage.

3.24 AWSB through the contractor proceeds to construct the sewerage. Procurement of the necessary tools, machinery and services is done at this stage. Construction of the sewerage in Kenya is often carried out by contractors, but AWSB are expected to supervise and monitor their delivery against the design brief and contract. The supervision is often subcontracted to consultant engineers who are responsible for active supervision while AWSB only does minimal supervision. Before commissioning the completed infrastructure, AWSB together with the consultant engineer and contractor test the sewerage to assess the delivery and operation of features in the design, controls and residual impacts.

c) Operational Service

3.25 Once the construction of the sewerage is complete, AWSB hands it over to WSPs who then use it to deliver sewerage services. AWSB work hand in hand with WSPs who handle operations and minor maintenance of developed sewerage. In case of a

major break down in the infrastructure, AWSB is expected to undertake maintenance works.

3.26 According to AFROSAI-E Guidelines on Maintenance of Assets (2010), there are three main types of maintenance: routine, periodic and emergency. Routine maintenance includes a range of normally small scale activities to ensure the asset's continuous operation. Periodic maintenance occurs less frequently and is carried out at predetermined intervals or according to predetermined criteria. It is normally large scale and often requires specialist equipment and skilled labour. Finally, emergency maintenance is occasionally urgent, unplanned actions that are required. This may arise from an unexpected deterioration or damage of an asset, accidents, floods, or collisions among others.

Funding for Athi Water Service Board

3.27 AWSB is a Public Corporation funded by the government through the budgetary allocation process. Apart from the moneys allocated by the government, AWSB receives agency fees from WSP it licenses. It also receives funds from bilateral and multilateral donor agencies particularly for capital projects either in the form of grants or loans. During the period covered by the audit, AWSB was undertaking major capital projects to rehabilitate and improve the sewerage infrastructure. **Table 1** shows expenditures on capital projects on sewerage infrastructure completed or substantially completed during the period under review.

Table 1: Expenditure on sewerage by AWSB under various projects

Project Name	Activities	Start	End	Cost (KSh)	Status
NaRSIP Lot 1 (Kiu River and Dandora trunk sewers)	Construction of Kiu and Dandora Trunk Sewers and expansion of Dandora Estate Waste Water Treatment Plant (DEWWTP)	March 2011	Nov. 2015	1,500,000,000	Completed
Gatharaini Trunk Sewers	Construction of Ruai, Gatharaini, Clay works and Ruaraka trunk sewers	April 2010	2014	1,300,000,000	Completed
Nairobi Water and Sewerage Emergency Physical Investment Project (NWSEPIP) Mukuru Sewers	Construction of sewers in Mukuru kwa Njenga area	March 2011	April 2014	93,700,000	Completed
Total				2,893,700,000	

Source: Analysis of AWSB records

3.28 Apart from the expenditure on capital projects the audit revealed that AWSB does not incur any expenditure on monitoring of sewerage infrastructure.

Chapter 4

4.0 Audit Findings

4.1 Water Service Boards have made effort to provide sewerage since their establishment in 2005, following the enactment of Water Act, 2002. Data obtained during the audit revealed that AWSB has been implementing major projects aimed at rehabilitating and expanding sewerage in Nairobi city. The scope of some sewerage works implemented by the board between July, 2010 and June, 2015 are as shown in **Table 2**.

Table 2: Sewerage projects implemented in Nairobi during the period 2010/11-2014/15

Board	Project title	Project Scope	Completion status as at time of audit
AWSB	NaRSIP Lot I	Construction of Kiu and Dandora Trunk Sewers and expansion of DEWWTP	Completed
	NaRSIP Lot II	Construction of Mathare, Nairobi and Ngong Rivers Trunk Sewers	Ongoing
	NaRSIP Lot III	Construction of Dandora, Kangundo Road, Kibera, Upper Hill and Kirichwa Dogo Trunk Sewers	Ongoing
	NaRSIP Lot IV	Rehabilitation of Kariobangi waste water treatment plant	Ongoing
	Gatharaini Sewerage	Construction of Ruai, Gatharaini, Clay works and Ruaraka trunk sewers	Completed
	NWSEPIP Mukuru sewer lines	Construction of sewers in Mukuru kwa Njenga area	Completed

Source: OAG review of AWSB project documents

4.2 However, these projects have not resulted into an adequate sewerage, due to a number of challenges as discussed below. **Appendix 4** contains a summary of AWSB management’s comments on the issues raised.

Inadequate Identification of Sewerage Needs

4.3 Water Service Boards’ (WSBs) mandate under Section 53(1) of the Water Act, (2002) is to ensure the provision of efficient and economical water services. Investments in sewerage should thus offer the best solution in meeting the sewerage needs of the concerned towns. In this regard,

WSBs are expected to develop sewerage capital works plan based on the prevailing sewerage service needs, which should be identified in consultation with WSPs according to Section 21 (e) of WASREB’s Model Water Services Regulations and Clauses 6.3 and 9.1 of WASREB’s license conditions.

4.4 The audit, however, revealed that sewerage needs identification as conducted by AWSBs was inadequate, leading to implementation of projects that do not fully address the sewerage service delivery needs of Nairobi.

- 4.5 The audit revealed that AWSB has implemented several capital works aimed at rehabilitating and expanding the sewerage system in Nairobi. However, the audit team requested for the needs assessment documents for these projects, but none was availed. The team was, however, informed that these projects were based on the recommendations of the 1998 Nairobi Master Plan for Sewer, Sanitation and Drainage. While the Master Plan outlines sewerage service gaps, it was very broad and covers an elongated period and may not have provided the current picture of the prevailing sewerage needs in Nairobi City. Besides, a capital works plan detailing the planned sewerage interventions as required by Clauses 6.3 and 9.1 of WASREB's license conditions was not made available for audit review.
- 4.6 As users of the sewerage, one would expect NCWSC to play a big role in sewerage needs identification. However, interviews with NCWSC staff revealed that it has limited involvement in the planning stages of projects. It was further established that AWSB reserves the right to the final decision even in instances where NCWSC is consulted, as the board may decide not to factor in NCWSC's input.
- 4.7 For example, interviews and document review revealed that AWSB proceeded with the construction of Kiu Rivers pump station constructed within the DEWWTP even with opposition of NCWSC. NCWSC opposed the facility through a letter in which it cited the unsustainability of pump stations due to problems with maintenance of the mechanical works, which are imported technology. According to NCWSC, the defunct Nairobi City Council was forced to decommission almost all of its pumping stations in 1982 due to the high operation and maintenance costs involved. However, AWSB went ahead and constructed the pump station, which has now been handed over to NCWSC for operation and maintenance.
- 4.8 Our visit to NCWSC further revealed that the company has hired a consultant to do a comprehensive sewerage needs assessment for Nairobi City. However, the staff interviewed informed us that the resultant needs assessment document will be presented to the County Government of Nairobi and not AWSB. Interviews with AWSB revealed that NCWSC has somehow stopped reporting to the board and instead reports to the County Government following the devolution of water services. This is so although the Water Act, 2002 which defines the relationship between WSBs and WSPs is still operational.
- 4.9 Inadequate needs identification meant that some of the sewerage developed by the board do not address the current sewerage service provision needs of Nairobi City. Interviews with staff of NCWSC as well as WASREB revealed that the capital works undertaken by AWSB have concentrated more on laying of trunk sewers with limited reticulation (distribution) sewers yet it is the latter that is actually used to connect households to the sewer system.
- 4.10 A review of project documents for three capital sewerage projects implemented in the period 2010/11-2014/15 revealed that AWSB delivered a total of 84.1 Km of trunk sewers with only 66.9 Km of reticulation sewers as outlined in **Table 3** and **Appendix 3**. Lot III of NaRSIP, for instance, delivered 15.5 Km of trunk sewers to cover Dandora estate treatment works, Kangundo road, Kibera, Upper Hill, and Kirichwa Dogo areas; but delivered only 1.2 Km of reticulation sewers as outlined in **Appendix 3**

Table 3: Sewer networks developed by AWSB during the period 2011/12-2014/15

	Project Name			Total
	NaRSIP	Gatharaini Sewers	NWSEPIP 4a-Mukuru Sewers	
Trunk Sewers (Km)	54.9	26.4	2.8	84.1
Reticulation (Km)	44.6	15.9	6.4	66.9

Source: OAG analysis of AWSB’s various project documents

4.11 Residents of the affected estates will therefore have to wait much longer before they can enjoy sewerage services despite trunk sewers passing within their vicinity. Besides, the achievement of Nairobi Rivers Basin Rehabilitation and Restoration Programme’s objective of enhancing environmental quality will continue to remain elusive so long as the reticulation sewers are not developed. Residents of the affected estates continue to discharge raw sewage into the environment and hence polluting the rivers. In some instances, residents of the affected estates are forced to shoulder the cost of reticulation sewers in order to connect to the laid trunk as was revealed by the review of documents.

4.12 Further, interviews and document reviews confirmed that some of the infrastructure being delivered by AWSB are difficult to operate and maintain thereby hampering the delivery of sewerage services to Nairobi City residents. In a letter to AWSB, NCWSC expressed concerns about the man holes developed under NaRSIP Lot I since they have small entry diameters making access of trunk sewers for maintenance difficult. This is in addition to the disputed Kiu river pump station, which NCWSC might not be able to maintain after all.

4.13 Field observations revealed that a similar investment incurred by AWSB in 2010 intended to automate litter collection at the DEWWTP failed

to deliver. The installed machines broke down and stalled in less than a year due to corrosion since they could not stand the high acidity of the effluent. Interviews with NCWSC revealed that AWSB did not adequately assess the needs before installing the machines, otherwise the board would have known that the machine would not stand the toxicity of the effluents. As at the time of the audit, the inlet works was being operated manually, allowing litter, including plastic bags, to pass and accumulate in the ponds as illustrated in **Plate 1**.

Plate 1: Littered pond in Dandora Estate Waste Water Treatment Plant



Notice the amount of litter in this pond sufficing as evidence of a malfunctioning inlet works

4.14 The inadequate needs assessment could be attributed to the apparent friction in the working relationship between AWSB and NCWSC to some extent; and dependence on recommendations of a very broad and long term baseline master plan with no assessment done to bring the current situation on board. Again, the project’s scope is at times determined by donors hence AWSB has no option but to adhere to the donor conditions, even if they may not address the most pressing needs.

Delays in implementation of sewerage projects

4.15 Sewerage development usually takes the form of capital works project with specific start and end dates documented in the project document. Hence, WSBs are expected to follow project implementation dates closely since implementation delays can have serious implications. The audit, however, revealed that

sewerage rehabilitation and expansion projects undertaken by AWSBs have taken longer than their planned completion dates. The audit team analysed three (3) projects implemented by AWSB in Nairobi City. The audit revealed that none of these projects was delivered within the planned timeframe as shown in **Table 4**.

Table 4: Delays in completion of projects

Projects	Planned Start Date	A c t u a l Start Date	Planned Completion Date	A c t u a l Completion Date	Delays in Months	Reasons for the delays	Completion status
Gatharini sewerage	April, 2010	April, 2010	A p r i l , 2012	June, 2012	2	Wayleave challenges	98.2%
NWSEPIP 4a- Mukuru Sewers	Feb.2011	M a r c h , 2011	M a r c h , 2012	July, 2014	27	Wayleave challenges	Completed
NARSIP Lot 1	Oct. 2012	Nov. 2012	Oct.,2014	15 th March 2015	5	Wayleave challenge, contractor's slow progress , re-design of pump station	98%
NARSIP Lot 2	-	Nov. 2012	A p r i l , 2015	-	-	Wayleave encroachment and acquisition challenges	90%
NARSIP Lot 3	-	Jan. 2014	July, 2015	-	-	Wayleave challenges	68.7%
NARSIP Lot 4	-	February, 2015	February, 2016	-	-	Initial delay in approval of master list, insufficient work teams and inadequate work methodologies	27%

Source: OAG review of various AWSB project reports

4.16 As shown in **Table 4**, the NWSEPIP 4a-Mukuru Sewers was planned to take 12 months. However, the project started in March, 2011 and was completed in July, 2014, resulting in a delay of about 27 months. Further, NaRSIP Lot IV was expected to be completed by February 2016, but the progress report availed to the audit team revealed that the project was only 27% complete as at October, 2015. Information obtained from the project's consulting engineer revealed that only 32% of the work under Lot IV had been completed as at January, 2016.

4.17 The implementation delays were attributed to several factors. The audit team was informed that most of the way leaves in Nairobi have been encroached. While AWSB ought to have acquired

the way leaves before commencing projects, the process of way leaves acquisition was left to run concurrently with construction works. This resulted in delays caused by lengthy negotiations with encroachers. The team was further informed that some encroachers refused to move even after compensation, for example in Blue Estate.

4.18 In some instances, the contractors, in consultation with AWSB had to redesign projects after efforts to acquire way leaves proved futile. For example, the NaRSIP Lot I (Kiu River and Dandora Trunk Sewers) was redesigned to include a pump station after realizing that the land where some of the ponds were to be constructed was already encroached. Further part of Riara trunk sewers under NaRSIP Lot I was realigned to avoid

displacement of people. Such revisions had to be subjected through a bureaucratic approval process, hence leading to implementation delays.

- 4.19 Review of document revealed that implementation delays were also caused by contractors' inadequate performance. For example, NaRSIP Lot IV was to some extent delayed by the contractor's failure to bring equipment/tools to site in time.
- 4.20 Further, physical verification revealed that non availability of important documents such as design reports has also contributed to delays. For example, it was noted that information and documents like design reports, 'as built' drawings and operation manuals which are necessary for maintenance purposes were not available at the Kariobangi Sewerage Treatment Plant where major rehabilitation was ongoing. The non-availability of these documents has adversely affected the rehabilitation work as the consultants and contractors have to simulate designs and plans in order to proceed with the rehabilitation.
- 4.21 The delays meant that the environment continued to be polluted awaiting completion of the sewerage projects as illustrated in **Plate 2**. The condition could even get

worse, especially in a situation where the raw sewage is diverted into a river to allow for rehabilitation of the existing infrastructure. Besides, the delays might lead to project cost escalations. For example, the 27 months delay recorded in NWSEPIP 4a-Mukuru Sewers led to a cost overrun of 7.7%. The initial cost of this project was Ksh. 155,028, 834.40, but it escalated to Ksh. 166,978,895 at completion.

Plate 2: Incomplete section of Sewer Blue Estate, Nairobi



Due to wayleave challenges the sewer line remained incomplete discharging raw sewage into the environment

Box 1: The Challenge of Wayleaves in Development of Sewer lines

A wayleave is a public right of way created for the purposes of laying of fuel pipe lines, water mains, sewer lines, power lines and communication lines. More often than not, sewer lines tend to utilize riverine riparian wayleaves in order to take advantage of natural gradients in their flow. While sewer wayleaves were originally provided for in every town's physical plans, increased urban population and weak enforcement of laws have led to their encroachment posing a great challenge to the development of sewer lines.

In Nairobi, for instance, it was noted that most of the riparian wayleaves have been encroached, generally in places like Kirichwa Ndogo, Mathare, Kariobangi and Kawangware among others. This mainly affected the implementation of NWSEPIP 4a- Mukuru Sewers and NaRSIP Lots I, II and III in which case some of the encroachers were reluctant to move even after compensation, for example in Blue Estate hence delaying the projects. It became impossible to lay down some sections of the sewer line due to the encroachment of wayleaves by permanent structures as was observed in the border between Mathare and Pangani estates. In some instances, AWSB was forced to acquire wayleaves from private land owners, but this was never easy. The consultant engineer for NaRSIP informed the team that KenHA charged them exorbitantly for every lane crossed along the Thika Super Highway, despite them using the under passes for rivers to lay the sewer lines without interfering with the road. The audit team also observed an unfinished 40m section of NaRSIP Lot I in Githurai-44 area due to a private land owner refusing to issue right of way despite AWSB willing to pay for the wayleave.



Notice the encroachment of buildings into wayleaves in Nairobi posing a challenge for laying down of sewer lines

The problem of wayleaves has been caused to a greater extent by conflicting sections of different sectoral laws. Scrutiny of documents revealed that the concept of riverine riparian reserve has been defined differently by various laws. For example, *Section 116(2) of the Water Resources Management Rules, 2006* and *Section 6(c) of EMCA (Water Quality) Regulations, 2006* provide for a minimum of six (6) metres to a maximum of 30 metres on either side of the river bank. On the other hand, *Section 15(c) and (d) of the Physical Planning Act, Chapter 286* provides for not less than 10 metres in width on each bank, except in areas where there is an established flooding of a river or stream. This matter is further compounded by weak enforcement of existing laws by relevant authorities and laxity on the part of WSBs to monitor existing sewer lines leading to buildings being constructed on wayleaves including those with existing sewer lines.

Some of the Sewerage facilities developed by AWSB are based on inappropriate technology, making them uneconomical to operate

- 4.22 According to Section 53 (1) of the Water Act, 2002, WSBs should not only endeavour to make water services (which include both water supply and sewerage) efficient but also economical. To achieve this, WSBs should use appropriate technology to deliver sewerage which is economical to operate and maintain.
- 4.23 The audit revealed that some of the sewerage facilities developed by WSBs are based on technology that is not appropriate for Kenya. Though very efficient in treating sewage, the mechanized treatment plants are energy intensive and have previously been abandoned by the WSPs due to high operation and maintenance costs.
- 4.24 Interviews and document review revealed that AWSB is currently rehabilitating the Kariobangi Waste Water Treatment Plant. This is a mechanised plant that relies on electricity for its operation. The equipment and machines being installed are imported. Interactions with the AWSB and NCWSC however, revealed that while electromechanical treatment plants are more efficient, they may not be appropriate for Kenya since they are energy intensive and spare parts for the installed machines are not readily available.
- 4.25 Although the current rehabilitation will improve the treatment efficiency, the plant may still fail to achieve its intended purpose due to the high cost of operation and maintenance involved. NCWSC may eventually abandon it as has happened before. Interviews with both AWSB and NCWSC and document reviews revealed that the Kariobangi Waste Water Treatment Plant was constructed in the 1950s and was functioning properly up to the late 1980s when it was considered completely run down due to failure to maintain and replace depreciating equipment. Thus the dilapidation of

the plant was mainly caused by abandonment by the defunct City Council of Nairobi due to the high cost of operation and maintenance on one hand and the non-availability of spare parts in the local market on the other.

- 4.26 Further, AWSB has constructed an energy intensive pump station just a few metres away from DEWWTP. NCWSC objected to the construction of the pump station, citing the high cost of operating and maintaining the imported components. Interviews with NCWSC revealed that the defunct City Council of Nairobi used to operate several pump stations, but they were all decommissioned in 1982 due to the high cost of operation and maintenance.
- 4.27 Field verifications revealed that an investment intended to mechanize the collection of trash at DEWWTP inlet works failed only a year after it was handed over to NCWSC. The machine broke down in 2010 and has not been repaired since then as NCWSC considered its maintenance costs too high. Interviews revealed that the required spare parts for the broken down machines are not available in the local market, hampering maintenance works. As the facilities are abandoned, the environment will continue to be polluted with partially treated sewage as has been the case of Kariobangi Waste Water Treatment Plant.
- 4.28 The use of inappropriate technology may be attributed to the inadequate consideration of local input in terms of technology and materials during planning, design and implementation of sewerage projects.

The existing sewerage has not been well maintained

- 4.29 According to section 53 (1) of the Water Act, 2002, WSBs are responsible for the efficient and economical provision of water services within their area of jurisdiction. Arising from this mandate, WSBs are not only expected to plan, develop and expand sewerage in accordance with Section 53 (3) (a), but also ensure that the existing

infrastructure is well maintained in accordance with Section 55 of the Water Act, 2002.

4.30 According to the Service Provision Agreement, when there is a maintenance issue the NCWSC is required to notify AWSB, cost it and make a quotation for the same which is submitted to AWSB. The NCWSC is then expected to go ahead and repair then bill the AWSB. In cases where NCWSC are unable to perform, they are expected to inform AWSB to take action.

4.31 Although the SPA appears to fully delegate repairs and maintenance to the NCWSC, it would ordinarily be expected that as owners of the assets, AWSB must take action to save the situation where it has been shown that the NCWSC is unable to carry out the repair or maintenance. Further, interviews with AWSB and NCWSC revealed that maintenance activities had been classified into two: major maintenance done by the board; and minor maintenance done by the service providers (NCWSC).

4.32 Field observations revealed various instances of burst sewers, open and overflowing manholes and blocked sewers within Nairobi as illustrated in Plate 3. As a result, the environment is polluted with raw sewage from the failed system. The open manholes are at times used as dumping ground for solid waste further causing blockages in the system.

Plate 3: An Overflowing Manhole Near Museum Hill Round About along Nairobi River



Notice the raw sewage flowing from the manhole causing pollution to Nairobi River

4.33 Our visit to DEWWTP revealed that an automated machine installed at the inlet works to collect and trapped litter at the filters broke down in 2010 and has not been repaired to date. The trash crusher also broke down in 2013 and no repairs have been done to date. As a result, much of the solid waste, including plastics which the system is intended to trap escape into the ponds. It was observed that the DEWWTP stabilisation ponds had plastics and other solid waste floating all over. Besides, the litter is collected manually, left to dry before it is burnt, posing an air pollution hazard.

4.34 Further, the team was informed that Kariobangi waste water treatment works broke down in the 1980s, but was still being operated in its dilapidated state, hence discharging partially treated sewage into Nairobi Rivers. Rehabilitation works of the plant started just recently in 2015.

4.35 As a result of inadequate maintenance, the treated sewage being discharged back to the environment both from DEWWTP and Kariobangi waste water treatment works do not meet NEMA recommended quality standards as measured by Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Suspended Solids (TSS). Table 5 illustrates the quality level of effluents discharged back to the environment from Kariobangi waste water treatment works during the audit period.

4.36 While the audit team was not provided with comprehensive data on the effluent quality analysis from DEWWTP, data provided revealed that DEWWTP did not meet NEMA effluent quality standards during the period July, 2014 to March, 2015. The effluents from the plant recorded a COD average of 198.67 mg/l against NEMA's 50 mg/l, indicating high concentration of chemicals in the effluent. Field verifications also revealed that the effluent discharged back from DEWWTP has a high concentration of nutrients, especially phosphates and nitrates as depicted by the colour of the effluent in **Plate 4**.

Table 5: Compliance of Kariobangi Waste Water Treatment Plant during the Period July 2011 to June 2015

	NEMA Standards	Average parameter concentration in effluent from the plant during the reporting period					Remarks
		2010/11	2011/12*	2012/2013	2013/14	2014/15**	
BOD (mg/l)	30	180	177.4	157	172.5	166	Not complying
COD (mg/l)	50	348.2	359.8	292.8	364.4	328.5	Not complying
TSS (mg/l)	30	91.1	77.5	88.3	171.6	68.1	Not complying

* Data analysed covered only July-December, 2011, **Data for April-June, 2015 was not available

Source: OAG analysis of Kariobangi Treatment Plant’s Quality Analysis Reports

Plate 4: Physical appearance of water at Dandora ponds outlet terrace



Notice the green colour of effluent indicating high level of algae, a clear indication of high concentration of nutrients, especially phosphates and nitrates.

- 4.37 The inadequate maintenance of sewerage was attributed to the confusion that exists with regard to the application of Item 10 of SPA that delegates repairs and maintenance to NCWSC without clearly specifying the responsibilities with respect to the nature and extent of repairs required.
- 4.38 Again, AWSB as owners of the assets has failed to monitor the assets condition and take action where NCWSC has been unable to do so. Thus due to the unclear mandate, a breakdown of infrastructure may take long to repair while the damage to the environment continued, due to the fact AWSB and NCWSC are not taking action as required.
- 4.39 Further, the team was informed that NCWSC no longer reports to AWSB regularly about its operations, but instead report to the County

Government of Nairobi, following the devolution of water services in Schedule 4 Part 2(11) of the Constitution of Kenya, 2010. As such, AWSB is not able to keep track of the maintenance activities being undertaken by NCWSC.

- 4.40 The problem is further compounded by the fact that AWSB does not undertake routine monitoring of the sewerage as the custodians of the infrastructure. AWSB failed to provide evidence that they do monitor or inspect the status of sewerage system. As a result, the sewerage system has been encroached further hampering maintenance works. At the DEWWTP, it was observed that the area occupied by the facility is not clearly demarcated. As a result, private structures have come up on what is claimed to be the plant’s land. This affected recent expansion works at the plant in which it was not possible to construct a series of ponds to expand the capacity of the plant. A pump station was constructed instead to redirect the Kiu River line to the DEWWTP main inlet.
- 4.41 The problem of land was also evident at Kariobangi Waste Water Treatment Plant where it was claimed that only 8 hectares of the initial 25 hectares is currently available for the plant. However, AWSB did not provide any evidence of ownership of the 25 hectare parcel. At the moment, rehabilitation of the plant is ongoing. Part of the rehabilitation work is to erect a wall

around the entire 25 hectares facility's land. Enquiries and field verifications revealed that the erection of the wall started, but stalled along the way.

Plate 5: Human encroachment into Kariobangi Waste Water Treatment Plant



Notice the buildings constructed close to the treatment plant. Also notice the solid waste dumped next to the plant's inlet works by the encroachers

Chapter 5

5.0 Conclusion

5.1 From the findings of the audit it is clear that AWSB has made significant effort to provide sewerage in Nairobi since its establishment with the enactment of Water Act, 2002. However, these efforts have not resulted in an adequate sewerage in Nairobi. The sewerage development projects implemented by the AWSB had shortcomings emanating from inadequate needs identification, use of inappropriate technology and delays in project implementation. Besides, the already developed infrastructure has been inadequately maintained further contributing to inadequacy of the sewerage system. More specific conclusions were made as follows:

- AWSB failed to treat needs assessment as an integral component of sewerage development. The board instead relied on recommendations of a long term baseline master plan which led to the implementation of projects that do not address the current sewerage needs of users in Nairobi.
- The appropriateness of technology is key to sustainability of sewerage. While the mechanized treatment plants and pump stations developed and rehabilitated in Nairobi look very efficient, the high operation and maintenance costs involved in such facilities poses a risk to their economical sustainability under the operation of NCWSC.
- Due to wayleave acquisition challenges and encroachment of land the implementation of sewerage projects in Nairobi recorded significant delays. This led to significant reduction in project scope or cost overruns.
- Due to the failure of AWSB to monitor the condition of sewerage infrastructure handed over to NCWSC, the existing sewerage has not been well maintained. .

Chapter 6

6.0 Recommendations

6.1 The following are the recommendations made by the Auditor-General to improve on the provision of sewerage in Nairobi City;

- To ensure that sewerage projects meet the current needs of Nairobi city
 - AWSB may consider putting more emphasis on identification of current sewerage needs when planning for sewerage projects. The boards should consider undertaking baseline studies when planning for sewerage projects to bring the current situation on board in addition to relying on recommendations from previous studies. The NCWSC and users of the sewerage should also be actively involved during needs assessment and their input considered when making the final decision.
- To address delays during implementation of sewerage projects:-
 - AWSB may need to consider acquiring wayleaves before commencing actual implementation of sewerage projects
 - AWSB should ensure that contractors strictly adhere to contract terms of references including project implementation timelines
- To ensure that the resultant sewerage facilities are cost effective:-
 - AWSB may consider ensuring that the mechanized treatment plants and pump stations are based on technologies and materials that are locally accessible and less energy intensive to encourage self-reliance
- To ensure that the existing sewerage is well maintained:-
 - AWSB in consultation with WASREB should clearly define the nature and extent of repair and maintenance responsibilities and be proactive in taking responsibility for the same
 - AWSB may consider developing mechanisms to ensure regular reporting of WSPs operations as provided for in the Service Provision Agreements
 - As owners, AWSB should regularly monitor and secure the sewerage infrastructure

Appendices

Appendix 1: Methods of gathering evidence

a) List of People Interviewed

Interviewee	Reasons for the interview
Director Technical Services, WASREB	To obtain understanding of regulation of sewerage services in Kenya.
Senior management of the AWSB Board	To obtain understanding of the operations of the boards including their role in the provision of sewerage services in their jurisdictional areas.
Key staff in charge of sewerage services at AWSB and WSP	To obtain understanding of the sewerage activities including the achievements and challenges.

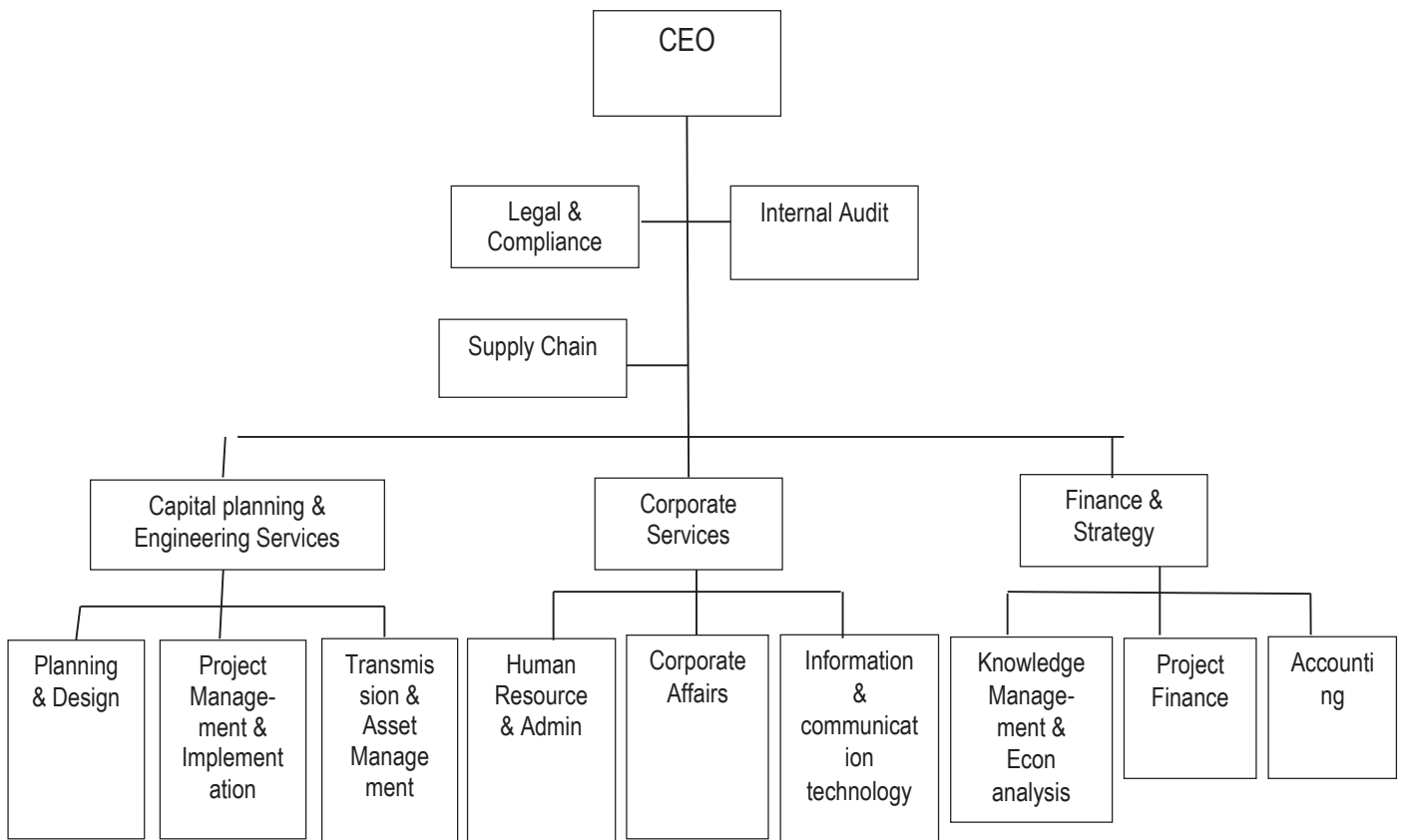
b) Documents Reviewed

Document Reviewed	Information Obtained
Constitution of Kenya	To obtain information on the constitutional provisions on environmental and social rights, especially the right to sanitation.
Water Act, 2002	To obtain information on the mandate for the provision of sewerage services
EMCA (Water Quality) Regulations	To obtain information on the environmental compliance requirements for sewerage service providers
National Water Services Strategy 2007-2015	To obtain information on short-term policy statements concerning provision of sewerage services
License documents for the Water Service Boards	To obtain information on licensing conditions.
Nairobi Water Master Plan, 2012	To obtain information on long-term policy statements concerning provision of sewerage services
Current strategic plans of the AWSB	To obtain background information, strategies, structures, SWOT analysis, and key stakeholders...
Contract documents	To obtain information on details on sewerage projects
Activity reports	To understand the progress of projects being implemented
Financial reports/budgets	To obtain information on the funding of activities
WASREB performance review reports	To obtain information on the status of sewerage services in the selected towns.

c) List of Sites Visited

Town	Facility	Activity
Nairobi	Dandora Estate Waste Water Treatment Plant	Waste water treatment
	Kariobangi Waste Water Treatment Plant	Waste water treatment
	Kiu River Pump Station	Waste water pumping
	Githurai 44	Wayleave encroachment
	Githurai 45	Wayleave acquisition challenge
	KURA bridge on Eastern Bypass	Box culvert, manhole connectivity
	Dandora Estate Waste Water Treatment Plant Junction	Challenge of laying sewer lines across roads
	Mathare Estate	Wayleaves challenges

Appendix 2: AWSB Organizational Structure



Source: AWSB strategic plan 2012-2017

Appendix 3: Breakdown of Sewers Developed by AWSB

Project Name	Component	Scope/coverage	Length of trunk sewers (Km)	Length of reticulation sewers (Km)
Nairobi Rivers Sewerage Improvement Project (NaRSIP)	Lot I	Construction of Kiu and Dandora Trunk Sewers and expansion of Dandora Estate Waste Water Treatment Plant	17.7	10
	Lot II	Construction of Mathare, Nairobi and Ngong Rivers Trunk Sewers	21.7	33.4
	Lot III	Construction of Dandora, Kangundo Road, Kibera, Upper Hill and Kirichwa Dogo Trunk Sewers	15.5	1.2
Gatharaini Sewers	Ruai outfall trunk sewer	Stretches from manhole MF 127 in Dandora Estate trunk sewers to manhole GMH-01 between Githurai 45 and Mwiki	5.3	0
	Gatharaini North trunk sewer	Stretches from manhole GMH-01 to Marurui	8.2	0
	Gatharaini South trunk sewer	Stretches from Maruri traversing Mwiki Estate, Kasarani Stadium, ICIPE, across Thika Highway and Safari Park hotel to Thome Estate	8.4	15.9*
	Clay works trunk sewer	Passes through Clay works estate, Thika Highway and terminates at Zimmerman next to Kamiti road	3.1	
	Ruaraka trunk sewer	Runs from Allsopps through Garden Estate to Ridgeways	1.4	0
N W S E P I P 4a- Mukuru Sewer line		Sewers in Mukuru kwa Njenga area	2.8	6.4

*The reticulation sewers were laid in Mwiki, Kasarani and Zimmerman Estates

Appendix 4: Response of the Chief Executive Officer on the Audit Findings

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>I. Inadequate Identification of Sewerage Needs</p>		
<p>The audit noted that AWSB had implemented several capital works projects aimed at rehabilitating and expanding the sewerage system in Nairobi. The team was informed that these projects were based on the recommendations of the 1998 Nairobi Master Plan for Sewer, Sanitation and Drainage. While the Master Plan outlines sewerage service gaps, it was broad based and covers an elongated period and may not have provided the current picture of the prevailing sewerage needs in Nairobi City. Besides, the team was not provided with a capital works plan detailing the planned sewerage interventions as required by Clauses 6.3 and 9.1 of WASREB's license conditions.</p>	<p>Agreed. It is true that the capital works implemented were based on the recommendations of the 1998 Nairobi Sewerage Masterplan. The masterplan was validated and a validation report prepared prior to commencement of the works.</p> <p>Currently AWSB has engaged a consultant to update the 1998 sewerage masterplan and even include the satellite towns around Nairobi, with the final masterplan report expected to be ready by August 2017 for immediate implementation</p>	<p>The office appreciates the validity of the 1998 masterplan and efforts by AWSB to update the masterplan via the masterplan validation report which provides a current assessment of the condition of the sewerage. However, the WASREB licensing conditions require a capital works plan.</p>
<p>As users of the sewerage, one would expect NCWSC to play a big role in sewerage needs identification. However, interviews with NCWSC staff revealed that it was somehow involved in the planning stages of projects, though to a limited extent.</p>	<p>Agreed. NCWSC was involved in the sewerage needs identification process and officers from NCWSC were assigned to each of the projects to assist in monitoring project implementation</p>	<p>Agreed.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>It was further established that AWSB reserves the right to the final decision even in instances where NCWSC was consulted and hence the board may decide not to factor in NCWSC's input. For example, interviews and document reviews revealed that AWSB proceeded with the construction of Kiu Rivers pump station constructed within the DEWWTP even with opposition of NCWSC. NCWSC opposed the facility through a letter in which they cited the unsustainability of pump stations due to problems with maintenance of the mechanical works. According to NCWSC, the defunct Nairobi City Council was forced to decommission almost all of its pumping stations in 1982 due to the high operational and maintenance costs involved. However, AWSB went ahead and constructed the pump station, which has now been handed over to NCWSC for operation and maintenance.</p>	<p>Not Agreed. NCWSC was initially opposed to construction of the pumping station at DESTP due to the anticipated challenges of operations and maintenance. However after various engagements both AWSB and NCWSC came into agreement on the construction of a pump station since the need was based on a technical justification. Senior officers from NCWSC attended the pump testing and acceptance inspection at the factory.</p>	<p>The office has evidence showing the NCWSC's opposition on the construction of Kiu River Pump station but no further evidence showing an agreement between AWSB and NCWSC on the construction of a pump station was given.</p>
<p>A visit by the audit team to NCWSC further revealed that the company had hired a consultant to do a comprehensive sewerage needs assessment for Nairobi city. However, the staff interviewed informed the team that the resultant needs assessment document was to be presented to the County Government of Nairobi and not AWSB.</p>	<p>Agreed. Under the new dispensation, water and sanitation services provision is under the county governments. Since NCWSC is owned by the County government of Nairobi, it is obliged to report to the county on its activities. However, NCWSC and AWSB have continued to work together and plan for sewerage services in Nairobi. AWSB and NCWSC recently worked together to identify interventions on sewerage for Nairobi when a consultant commissioned by AWSB was preparing second phase of sewerage for Nairobi.</p>	<p>It is commendable that NCWSC and AWSB have recently worked together to identify interventions on sewerage for Nairobi.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>Inadequate needs identification meant that some of the sewerage developed by the board did not address the current sewerage service provision needs users. Interviews with staff of NCWSC as well as WASREB revealed that the capital works undertaken by AWSB had concentrated more on laying of trunk sewers with limited reticulation sewers yet it was the latter that was actually used to connect households to the sewer system</p>	<p>Agreed. Sewerage projects are capital intensive. With the budget that was available to implement the works, AWSB focused on construction of the primary networks (trunk sewers) but also included part of reticulation system. This is part of phased approach in investment because it is easier to lay the reticulation network once the primary infrastructure in place. AWSB has prepared designs and tender documents for implementation of work under NaRSIP II programme which will involve laying of over 170km reticulation sewers within Nairobi.</p>	<p>The office will do a follow-up of the NaRSIP Lot II project to check on the implementation of the reticulation sewers. .</p>
<p>A review of project documents for three capital sewerage projects implemented in the period 2010/11-2014/15 revealed that AWSB delivered a total of 84.1 Km of trunk sewers with only 66.9 Km of reticulation sewers. Lot III of NaRSIP, for instance, delivered 15.5 Km of trunk sewers to cover Dandora estate treatment works, Kangundo Road, Kibera, Upper Hill, and Kirichwa Dogo areas, but only 1.2 Km of reticulation sewers.</p>	<p>Agreed. Reticulation sewers cannot be implemented in the absence of trunk sewers hence the primary focus is in the construction of trunk sewers first. Expansion of reticulation sewers is phased based on availability of funds. Focus cannot however be put on reticulation sewers when trunk sewers are not existing. AWSB has prepared designs and tender documents for works implementation under NaRSIP II programme which will involve laying of over 170 km reticulation sewers within Nairobi.</p>	<p>The office agrees that reticulation sewers cannot be implemented in the absence of trunk sewers, however AWSB may need to consider laying trunk sewers concurrently with the reticulation sewers to ensure that households are connected to the sewer lines.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>Residents of the affected estates will therefore have to wait much longer before they can enjoy sewerage services despite trunk sewers passing within their vicinity. Besides, the achievement of Nairobi Rivers Basin Rehabilitation and Restoration Programme's objective of enhancing environmental quality will continue to remain elusive so long as the reticulation sewers are not developed.</p>	<p>Agreed. As earlier discussed, investment in sewerage is capital intensive and the capital infrastructure constructed is based on available funds. Reticulation sewers will continue to be constructed depending on the available funds from both the national and county governments. AWSB has prepared designs and tender documents for works implementation under NaRSIP II programme which will involve laying of over 170 km reticulation sewers within Nairobi.</p>	<p>Some causes of unsatisfactory performance are operational and administrative and require system reform and not necessarily additional funds for improvement to be realized.</p>
<p>Interviews and document reviews confirmed that some of the infrastructure that was being delivered by AWSB was difficult to operate and maintain thereby hampering the delivery of sewerage services to Nairobi city residents. In a letter to AWSB, NCWSC expressed concerns about the man holes developed under NaRSIP Lot I since they had small entry diameters making access of trunk sewers for maintenance difficult. This was in addition to the disputed Kiu river pumping station.</p>	<p>Agreed. The entry diameters for the manholes were based on the standard drawings that have been developed for manhole construction. Demonstrations on operation and maintenance were carried out on site and it was agreed that the manhole size was adequate for operations .Other minor adjustments raised by NCWSC were considered and adjusted on site.</p>	<p>Some causes of unsatisfactory performance are operational and require system reform to be realized.</p>
<p>The inadequate needs assessment could be attributed to the apparent friction in the working relationship between AWSB and NCWSC to some extent and dependence on recommendations of a very broad and long term baseline master plan with no assessment done to bring the current situation on board. Again, the project's scope is at times determined by donors hence AWSB has no option but to adhere to the donor conditions, even if they may not address the most pressing needs.</p>	<p>Agreed. As earlier discussed, NCWSC was involved in all aspects of project implementation, from planning to actual construction .The project scope was determined from the sewerage masterplan which has been assessed and validated to show its relevance. AWSB selected the scope of works to be done and this was not under the influence of the donor.</p>	<p>The office appreciates the validity of the 1998 masterplan and efforts by AWSB to update the masterplan via the masterplan validation report which provides a current assessment of the condition of the sewerage.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>II. Delays in implementation of sewerage projects</p>		
<p>The implementation delays were attributed to several factors. The team was informed that most of the way leaves in Nairobi had been encroached. While AWSB ought to have acquired the way leaves before commencing projects, the process of way leaves acquisition was left to run concurrently with construction works. This resulted in delays caused by lengthy negotiations with encroachers.</p>	<p>Agreed. AWSB endeavored to clear all wayleave issues ahead of the construction works. A team of sociologists was recruited to handle wayleave issues ahead of the construction works. However, certain sections took longer to negotiate for wayleave than had been envisaged and hence caused delays to the construction works</p>	<p>The AWSB should consider acquiring the way leaves before commencing projects, to avoid delays by starting the processes early.</p>
<p>The team was further informed that some encroachers refused to move even after compensation, for example in Blue Estate. In some instances, the contractors, in consultation with AWSB had to redesign projects after efforts to acquire way leaves proved futile. For example, the NaRSIP Lot I (Kiu River and Dandora Trunk Sewers) was redesigned to include a pumping station after realizing that the land where some of the ponds were to be constructed was already encroached. Further part of Riara trunk sewers under NaRSIP Lot I was realigned to avoid displacement of people. Such revisions had to be subjected through a bureaucratic approval process, hence leading to implementation delays.</p>	<p>Agreed. There were instances where buildings were constructed up to the river bed and because the developers had the requisite ownership documentation, it took too long to negotiate for relocation and upon valuation of the development, it emerged that it would be too costly to acquire and demolish the developments and hence AWSB realigned the sewers to avoid the developed areas. The area initially reserved for expansion of dandora estate WWTP has been encroached and hence there was no available land for expansion of the ponds. The siting of the pumping station at Dandora estate WWTP was necessitated by the fact that in order to serve the kahawa sukari, Githurai and the Kenyatta University areas, the sewage could not flow by gravity to the existing inlet works nor the nearby land, hence AWSB designing for a small section of pumping to the inlet works.</p>	<p>As owners of the assets, AWSB needs to secure them to protect from encroachment or land grabbing</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>Review of document revealed that implementation delays were also caused by contractors' inadequate performance. For example, NaRSIP Lot IV was to some extent delayed by the contractor's failure to bring equipment/tools to site in time.</p>	<p>Agreed. The contract for the Kariobangi WWTP rehabilitation is a 'design-and-Build' contract and was expected to design the rehabilitation works, then proceed to implement the actual works. Some of the delays to the implementation of the works was due to approvals of tax exemption to allow the contractor procure the electromechanical equipment.</p>	<p>No further comment.</p>
<p>The delays meant that the environment continued to be polluted awaiting completion of the sewerage projects. The condition could even get worse, especially in a situation where the raw sewage is diverted into a river to allow for rehabilitation of the existing infrastructure. Besides, the delays lead to project cost escalations. For example, the 27 months delay recorded in NWSEPIP 4a-Mukuru Sewers led to a cost overrun of 7.7%. The initial cost of this project was Ksh. 155,028, 834.40, but it escalated to Ksh. 166,978,895 at completion.</p>	<p>Agreed. AWSB made all efforts to rehabilitate any collapsed sewers ahead of construction works to ensure the spillage of raw sewage doesn't flow to the rivers. In liaison with NCWSC, all blocked sewers were unblocked to ensure full functioning of the facilities.</p> <p>All the projects implemented were fixed price and hence there was no window for variation of prices to the contracts. The increase in cost of the project was due to increase in scope of works including high quantities of rock excavation which had not been anticipate, and increase in length of sewer lines and waterlines laid and number of manholes constructed to ensure adequate coverage of water and sanitation services.</p>	<p>Field observations revealed various instances of burst sewers, open overflowing manholes and blocked sewers causing environmental pollution.</p> <p>The office agrees with the clarification on the increase in cost of the project caused by increase in scope of works.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>III. Some of the Sewerage facilities developed by AWSB are based on inappropriate technology, making them uneconomical to operate</p>		
<p>According to Section 53 (1) of the Water Act, 2002, WSBs should not only endeavor to make water services, which include both water supply and sewerage, efficient but also economical. To achieve this, WSBs should use appropriate technology to deliver sewerage which is economical to operate and maintain. The audit revealed that some of the sewerage facilities developed by AWSB were based on inappropriate technology for Kenya. Though very efficient in treating sewage, the mechanized treatment plants are energy intensive and have previously been abandoned by the WSPs due to high operation and maintenance costs</p>	<p>Not Agreed. The designs for expansion and rehabilitation of sewers by AWSB is based on most recent and efficient and economical technologies, with emphasis on low use of energy. Most of the sewage received at the treatment plants contains obstacles including dead animals and boulders which occasionally damage the inlet works installations at times rendering them un-operational. In order to ensure self-sustainability of the WWTP, AWSB has undertaken studies to harness methane gas for production of energy for both Dandora and Kariobangi WWTP to be used during operations of the plants so as to cut down the cost on energy consumption. AWSB is looking for financing to implement the proposed energy generation activities.</p>	<p>The office will do a follow-up to establish the sustainability of harnessing methane gas for production of energy for both Dandora and Kariobangi WWTP to be used during operations of the plants so as to cut down the cost on energy consumption.</p>
<p>Interviews and document review revealed that AWSB was rehabilitating Kariobangi Waste Water Treatment Plant. This was a mechanized plant that relies on electricity for its operation. The equipment and machines being installed were imported.</p> <p>Interviews with the AWSB & NCWSC revealed that while electro-mechanical treatment plants are more efficient, they may not be appropriate for Kenya since they are energy intensive and spare parts for the installed machines are not readily available.</p>	<p>Agreed. The design of the Kariobangi WWTP has taken into cognizance the availability of a local manufacturer partner to supply any spare parts which could be required in case of breakdown.</p> <p>The energy generation study undertaken by AWSB once implemented, will ensure the plant generates its own energy for operations and hence no expenditure of payments for energy supply.</p>	<p>The finding remains as reported.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>Although the current rehabilitation will improve the treatment efficiency, the plant may not achieve its intended purpose due to the high cost of operation and maintenance involved. NCWSC may eventually abandon it as had happened before.</p>	<p>Agreed. To ensure sustainability and efficiency, the plant is being rehabilitated using the modern equipment whose operations is easy and energy consumption is low. Moreover, upon implementation of the energy generation from the methane gas harnessed from the plant, the WWTP will be self-sustaining and operations costs will be very minimal.</p>	<p>The finding remains as reported.</p>
<p>Interviews with both AWSB and NCWSC and document reviews revealed that the Kariobangi Waste Water Treatment Plant was constructed in the 1950s and was functioning properly up to the late 1980s when it was considered completely run down due to failure to maintain and replace depreciating equipment. Thus the dilapidation of the plant was mainly caused by abandonment by the defunct City Council of Nairobi due to the high cost of operation and maintenance on one hand and the non-availability of spare parts in the local market on the other.</p>	<p>Agreed. AWSB through the support of the world bank is undertaking an organizational study for NCWSC to ensure efficiency of all staff at all sectors including WWTP.</p> <p>(Contract for NCWSC organizational study is attached to this report).</p> <p>Once concluded, operators of Kariobangi WWTP will be incentivized to be able to work efficiently and ensure the plant operates to its optimal capacity. The high costs of operating the plant will be minimized through installations of low energy consuming electromechanical equipment through the ongoing rehabilitation works, as well as generating internal energy for operations from the plant itself.</p>	<p>Some causes of unsatisfactory performance are operational and require system reform and not necessarily additional funds for improvement to be realized.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>AWSB had constructed an energy intensive pump station just a few meters away from DEWWTP. NCWSC objected to the construction of the pump station, citing the high cost of operating and maintaining the imported components. Interviews with NCWSC revealed that the defunct Nairobi City Council used to operate several pump stations, but they were all decommissioned in 1982 due to the high cost of operation and maintenance.</p>	<p>Not Agreed. The installations at the pumping station at DEWWTP are low energy consuming and hence very little costs will be incurred by the operator. Upon implementation of the energy generation from the WWTP sewerage plant, there will be enough energy to run the pump station hence no costs will be incurred thereafter</p>	<p>The audit finding remains as reported. The Office requires more evidence to show that the pumping station at DEWWTP are low energy consuming.</p>
<p>Field verifications revealed that an investment intended to mechanize the collection of trash at DEWWTP inlet works failed only a year after it was handed over to NCWSC. The machine broke down in 2010 and had not been repaired since then as NCWSC considered its maintenance costs too high. Interviews revealed that the required spare parts for the broken down machines were not available in the local market, hampering maintenance works. As the facilities are abandoned, the environment will continue to be polluted with partially treated sewage as has been the case of Kariobangi Waste Water Treatment Plant</p>	<p>Not Agreed. Rehabilitation works were implemented through financing by the AFD and the inlet works restored to full operation and handed over for operations by NCWSC.</p> <p>AWSB has designed a modern and more efficient inlet works to be implemented under AFDB financing in the NaRSIP 2 programme.</p> <p>Once implemented, the inlet works will be restored to full operations through installations of modern electro mechanical equipment capable of handling the solid wastes received at the inlet works with sewage.</p> <p>Upon implementation of the energy generation project, the inlet works will be served from internally generated energy and hence no costs will be incurred during its operations</p>	<p>The audit finding remains as reported. The will do a follow up to establish if the rehabilitation works were implemented.</p> <p>The office acknowledges the efforts made by AWSB to install a modern and more energy efficient inlet works.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>The use of inappropriate technology may be attributed to the inadequate consideration of local input in terms of technology and materials during planning, design and implementation of sewerage projects.</p>	<p>Not Agreed. AWSB in its planning and designs to ensure participation of expertise from both local and international firms and personnel to provide the most modern, efficient and cost effective processes and installations for implementation of sewerage projects. The consultants involved in the planning, design and implementation of both DEWWTP and Kariobangi WWTP had the requisite expertise for provision of consultancy services to ensure their operations and not only efficient but also cost effective and modern in terms of technical advancements</p>	<p>The audit finding remains as reported since no evidence was provided to show participation of both local and international firms in the planning, design & implementation of both DEWWTP and Kariobangi WWTP</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>IV. The existing sewerage has not been well maintained</p>		
<p>According to section 53 (1) of the Water Act, 2002, WSBs are responsible for the efficient and economical provision of water services within their area of jurisdiction. Arising from this mandate, WSBs are not only expected to plan, develop and expand sewerage in accordance with Section 53 (3) (a), but also ensure that the existing infrastructure is well maintained in accordance with Section 55 of the Water Act, 2002.</p>	<p>Not Agreed. AWSB plans, and implements water and sewerage projects within its area of jurisdiction. In order to ensure proper operations and maintenance of the developed infrastructure by respective WSPs, a service provision agreement is signed to stipulate the specific activities and levels of performance expected from the infrastructure. AWSB further undertakes monitoring and evaluation of these infrastructure to assess the performance levels and areas of intervention in terms of expansion, rehabilitation and duplication.</p>	<p>Although the SPA appears to fully delegate repairs and maintenance to the NCWSC, it would ordinarily be expected that as owners of the assets, AWSB must take action to save the situation where it has been shown that the NCWSC is unable to carry out the repair or maintenance.</p>
<p>According Service Provision Agreement, when there is a maintenance issue the NCWSC is required to notify AWSB and make a financial quotation for the same. The NCWSC is then expected to go ahead and repair then bill the AWSB. In cases where NCWSC are unable to perform, they are expected to inform AWSB to take action.</p> <p>Although the SPA appears to fully delegate repairs and maintenance to the NCWSC, it would ordinarily be expected that as owners of the assets, AWSB must take action to save the situation where it has been shown that the NCWSC is unable to carry out the repair or maintenance.</p>	<p>Not Agreed. The service provision agreement signed between AWSB and NCWSC stipulates the extent of interventions with regards to infrastructure development and maintenance to ensure assets are operated efficiently</p>	

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>Field observations revealed various instances of burst sewers, open and overflowing manholes and blocked sewers within Nairobi. As a result, the environment is polluted with raw sewage from the failed system. The open manholes were at times used as dumping ground for solid waste further causing blockages in the system.</p>	<p>Agreed. AWSB and NCWSC have faced challenges to use of existing sewerage infrastructure due to misuse through dumping of solid waste, deliberate blockages by people to use waste water for irrigation, vandalism of manholes covers to extract metal for sale, amongst others. Frequent unblocking of these sewers has ensured minimal spillage of waste water to the environment.</p> <p>In order to ensure minimal interference to sewer networks, use of manhole covers which are nonmetallic has been incorporated in recent sewer designs. Overloading of sewers due to increased flows leads to overflows within the sewer manholes, and AWSB is currently expanding all sewer infrastructure within Nairobi to relieve the overload sections of sewers, a second phase of NaRSIP programme has been designed to lay over 275km of sewer lines within Nairobi. A sanitation masterplan is also under preparation by AWSB to identify the investments required for implementation up to the year 2040.</p>	<p>The Office will assess and report on implementation of the recommendations during a follow up audit to be conducted on a time-frame agreed with the AWSB.</p>
<p>A visit to DEWWTP revealed that an automated machine installed at the inlet works to collect and trapped litter at the filters broke down in 2010 and had not been repaired. The trash crusher also broke down in 2013 and no repairs were done. As a result, much of the solid waste, including plastics which the system was intended to trap escape into the ponds. It was observed that the DEWWTP stabilization ponds had plastics and other solid waste floating all over. Besides, the litter was now being collected manually; left to dry before it was burnt, posing an air pollution hazard.</p>	<p>Agreed. AWSB has designed a modern DEWWTP inlet work project and has secured financing from the AFDB for implementation.</p> <p>Procurement of the contractor will commence by October 2017. Once implemented, the inlet works will be rehabilitated and expanded to operate to the current capacity of flow receive. The solid wastes which accidentally find their way to the ponds are collected and hauled with tractors and deposited at the Dandora solid dumpsite.</p>	<p>The finding remains as reported.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>Further, the team was informed that Kariobangi waste water treatment works broke down in the 1980s, but was still being operated in its dilapidated state, hence discharging partially treated sewage into Nairobi Rivers. Rehabilitation works of the plant started in 2015.</p> <p>As a result of inadequate maintenance, the treated sewage being discharged back to the environment both from DEWWTP and Kariobangi waste water treatment works did not meet NEMA recommended quality standards as measured by Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Suspended Solids (TSS).</p>	<p>Agreed. The rehabilitation of Kariobangi WWTP is ongoing and anticipated to be completed by September 2017. In order to ensure the raw sewage doesn't flow to the river, a diversion channel has been constructed to convey excess sewage flows from Kariobangi to DEWWTP for treatment, hence no raw sewage flows to the river currently.</p> <p>The concentration of treated sewage for both Kariobangi and Dandora WWTP at times exceed the required standards and AWSB is planning to construct wetlands to provide secondary treatment of the sewage before discharge to ensure compliance to required standards.</p>	<p>The audit finding remains</p>
<p>While the audit team was not provided with comprehensive data on the effluent quality analysis from DEWWTP, data provided revealed that DEWWTP did not meet NEMA effluent quality standards during the period July, 2014 to March, 2015. The effluents from the plant recorded a COD average of 198.67 mg/l against NEMA's standard of 50 mg/l, indicating high concentration of chemicals in the effluents.</p> <p>Field verifications also revealed that the effluents discharged back from DEWWTP has a high concentration of nutrients, especially phosphates and nitrates as depicted by the green color</p>	<p>Not Agreed. The data analysis results for the waste water discharged to the river at DEWWTP are recorded on a daily basis and accessed at the laboratory at the offices of NCSWC within the treatment plant. The effluent discharged at Dandora is in the ranges of 30mg/l of BOD and is always in compliance to NEMA standards, which has always been found less compared to the river water.</p> <p>During implementation of the NaRSIP project, AWSB through the consultant was undertaking quarterly environmental audits and prepared reports which are available.</p>	<p>The audit finding remains as reported since no data was provided on the effluent quality from DEWWTP.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>The inadequate maintenance of sewerage was attributed to the confusion that exists with regard to the application of Item 10 of SPA that delegates repairs and maintenance to NCWSC without clearly specifying the responsibilities with respect to the nature and extent of repairs required.</p> <p>Again, AWSB as owners of the assets has failed to monitor their condition and take action where NCWSC has been unable to do so.</p> <p>Thus due to the unclear mandate, a breakdown of infrastructure may take long to repair while the damage to the environment continued, due to the fact AWSB and NCWSC are not taking action as required.</p> <p>For example, interactions with both AWSB and NCWSC indicated that the repair and rehabilitation of the intake point at DEWWTP had not been done partly due to the fact that NCWSC was unable to do it and AWSB had not taken action to repair or replace it as the owners of the assets.</p>	<p>Agreed. The service provision agreement between AWSB and NCWSC stipulates clearly the extent of intervention activities for each of the two parties. Moreover, consultations are always done during implementation of sewerage infrastructure so that both AWSB and NCWSC are involved.</p>	<p>Although the SPA appears to fully delegate repairs and maintenance to the NCWSC, it would ordinarily be expected that as owners of the assets, AWSB must take action to save the situation where it has been shown that the NCWSC is unable to carry out the repair or maintenance.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>Further, the team was informed that NCWSC no longer reported to AWSB regularly about its operations, but instead reported to the County Government of Nairobi, following the devolution of water services in Schedule 4 Part 2(11) of the Constitution of Kenya, 2010. As such, AWSB was not able to keep track of the maintenance activities being undertaken by NCWSC.</p> <p>The problem was further compounded by the fact that AWSB did not undertake routine monitoring of the sewerage as the custodians of the infrastructure. AWSB failed to provide evidence that they did monitor or inspect the status of sewerage system. As a result, the sewerage system has been encroached further hampering maintenance works.</p>	<p>Not Agreed. The current water bill 2016 has proposed the formation of water works development agencies to undertake activities at national level as is currently being implemented by the WSBs. The formation of these development agencies is still being a waited as such the current operations is expected to be under the framework of the water act 2002</p> <p>AWSB undertakes monitoring and evaluation of all water and sewerage infrastructure and reports prepared which can be availed if required.</p>	<p>The office acknowledges the proposed formation of water works development agencies to undertake activities at national level.</p> <p>The audit finding remains as reported since no evidence was provided to show AWSB's effort to monitor and evaluate the status of its sewerage infrastructure.</p>

Audit Finding	Chief Executive Officer's Response	OAG's Remarks on CEO's Response
<p>At the DEWWTP, it was observed that the area occupied by the facility was not clearly demarcated. As a result, private structures have come up on what is claimed to be the plant's land. This affected recent expansion works at the plant in which it was not possible to construct a series of ponds to expand the capacity of the plant. A pump station was constructed instead to redirect the Kiu River line to the DEWWTP main inlet.</p>		<p>AWSB should regularly monitor the status and secure the sewerage infrastructure and other assets</p>
<p>The problem of land was also evident at Kariobangi Waste Water Treatment Plant where it was claimed that only 8 hectares of the initial 25 hectares was currently available for the plant. However, AWSB did not provide any evidence of ownership of the 25 hectare parcel and rehabilitation of the plant was ongoing at the time. Part of the rehabilitation work was to erect a wall around the entire 25 hectares of the facility's land. Enquiries and field verifications revealed that the erection of the wall started, but stalled along the way.</p>		

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