THE REPUBLIC OF UGANDA

OFFICE OF THE AUDITOR GENERAL

MANAGEMENT OF SEWAGE IN URBAN AREAS BY NATIONAL WATER AND SEWERAGE CORPORATION

VALUE FOR MONEY AUDIT REPORT

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AUDITOR GENERAL'S MESSAGE

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31st March 2015

The Rt. Hon. Speaker of Parliament
Parliament of Uganda
Kampala

REPORT OF THE AUDITOR GENERAL ON MANAGEMENT OF SEWAGE IN URBAN AREAS BY NATIONAL WATER AND SEWERAGE CORPORATION

In accordance with Article 163(3) of the Constitution. I hereby submit my report on the audit undertaken on Management of Sewage in Urban Areas by National Water and Sewerage Corporation.

My office intends to carry out a follow – up at an appropriate time regarding actions taken in relation to the recommendations in this report.

I would like to thank my staff who undertook this audit, and the staff of National Water and Sewerage Corporation for the assistance offered to my staff during the period of the audit.

John F. S. Muwanga
AUDITOR GENERAL

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LIST OF ABBREVIATIONS

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
ESIA	Environmental and social impact assessment
GDP	Gross Domestic Product
KSMP	Kampala sanitation master Plan
KSP	Kampala sanitation programme
NEMA	National Environment Management Authority
NWSC	National Water and Sewerage Corporation
STP	Sewerage treatment plant
TSS	Total suspended solids
WWTP	Waste water treatment plant

EXECUTIVE SUMMARY

Management of sewage is an important aspect of urban sanitation and plays a key role in the economic transformation of any country. In Uganda today, urban sanitation or lack of is a concern affecting people, which has been noted as a root cause of an average of 3,000 cases of cholera affecting Uganda. Statistics also indicate that poor sanitation costs Uganda 389 billion shillings annually, which is about 1.1% of the National GDP.

Management of sewage in Uganda is a mandate of National Water and Sewerage Corporation (NWSC) and involves all activities of collection, transportation and treatment of raw sewage before discharge to the environment. It has, however, been observed that urban sewage management still faces a number of challenges which have hindered the achievement of national sanitation objectives.

KEY FINDINGS

NWSC has made significant strategic efforts to ensure that there is adequate management of sewage in urban areas by, for example, coming up with the Kampala Sanitation Master plan (KSMP); however, through this audit ,there are a number of areas that have been identified that still require attention in order to improve sewage management in urban areas.

- Although NWSC had undertaken steps to improve access to sewerage services, access is still low and has not significantly improved over time, access of the total population serviced by NWSC to sewerage services for the years 2011/12 and for 2012/13 was 6.4% and 6.7%, respectively.

- Effluent discharged by NWSC to the environment does not meet the effluent standards for the different parameters as set by NEMA.

- NWSC has for the past three years been discharging effluent to the environment without permission in the form of a valid discharge permit.

- From physical observation the sewage treatment infrastructure, especially the stabilization ponds are poorly maintained, with overgrown bushes and large volumes of sludge build up.

- The existing coordination mechanism between NWSC and other key stakeholders in the sewage management process had not yielded effective levels of coordination.

- NWSC lacked vital operation data and records, for example, daily flow data, volume of effluent discharged to the environment, and records about quality and source of influent.

KEY RECOMMENDATIONS

- Since access to sewerage services is a key aspect of sewage management, there is need to implement proposed strategies to ensure increased access.
- NWSC should implement measures to enhance the operational efficiency of the treatment infrastructure and ensure that the quality of influent is monitored.
- Management of NWSC should ensure that they obtain valid discharge permits from the Ministry of Water and Environment in a timely manner and comply with the conditions set therein.
- NWSC should expedite the process of procuring better equipment to ensure that all areas of operation carry out satisfactory maintenance and further enhance its monitoring of upcountry areas to ensure that desludging is done on a regular basis.
- NWSC should endeavour to enhance coordination with other key stakeholders to ensure achievement of improved sewage management in the operation areas.
- NWSC should put in place measures to ensure that operational data and data is kept and regularly maintained to facilitate operation and maintenance of infrastructure.

OVERALL AUDIT CONCLUSION

Although NWSC has undertaken some interventions to increase access to sewerage services, especially within Kampala, there is still need for more interventions, especially in areas outside Kampala. Access of the total population served by NWSC to sewerage services is still low- it stood at 6.7% in 2012/13 and this negatively affects the ability of NWSC to ensure that all the sewage generated is adequately collected and treated. With the current treatment process, NWSC cannot meet some of the quality national standards required for effluent discharged to the environment which poses a threat to both the environment and the humans. Maintenance of the existing waste water treatment infrastructure is still inadequate and this affects the effectiveness of the treatment process of the waste water collected, and the life span of the treatment infrastructure. Without up to date operational data, it becomes difficult and in some cases impossible to evaluate the performance of the infrastructure and identify factors that may compromise the effectiveness of the infrastructure.

NWSC thus needs to expedite on going interventions to further improve sewage management.

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CHAPTER ONE

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Poor sanitation and hygiene has been identified by the public as a concern and cause of various health and sanitation related problems. This is evidenced by the high number of sanitation related diseases such as diarrhea and cholera which are prevalent in Kampala and the other urban areas. Management of sewage is a key aspect of ensuring that the broader sanitation challenges are addressed.

1.2 MOTIVATION

Poor sanitation costs Uganda 389 billion shillings annually, equivalent to 1.1% of the national GDP. The economic implications of sanitation related illnesses go beyond the immediate health issues to loss of productivity, death, and reallocation of resources from other essential items.[1]

Access to effective sanitation in Kampala, like in many African cities, is limited and is not keeping pace with the rapid rate of urbanization and industrial growth in the city. Less than 7.5% of Kampala residents are served by a public sewer with the vast majority reliant on various forms of on-site sanitation of variable quality and effectiveness[2].

In Uganda, about 7.62 million m^3 of waste water (sewage) is generated annually and about half of this is in Kampala alone.[3] However, collection and treatment of this sewage remains a challenge because the existing treatment plants and technology is very old; and only 10% of Kampala's central business district is served by the sewerage network.[4]

[1] Economic Impact of poor sanitation in Africa: A study by the water and sanitation programme (WSP)2012
[2] Kampala Sanitation Master Plan 2004 –Vol 2. Page 1-1
[3] Waste water production, treatment and use in Uganda-Kayiizi ET al.2012.
4 Ibid

Fifty six percent (56%) of the pipes in Kampala were built in the 1940s and 86% of these have been operational for 35 years or more.[5] The system is therefore aging and it is likely that the rate of structural failure will increase leading to increased expenditure on sewer rehabilitation and replacement.

Even where the waste water is treated, reports show that the effluent does not meet national standards for discharge of waste water.[6] In fact, NWSC is listed among the biggest dischargers of effluent that does not meet national standards.[7]

Discharge of untreated waste water into lakes and rivers has a material impact on: human health, social and economic development and ecosystem sustainability.[8]

In Uganda, the waste water generated/produced and treated is comprised of mainly domestic and municipal waste.[9]

It is against this background that the Office of the Auditor General decided to undertake a review of sewage management by NWSC to ascertain the challenges faced and suggest possible recommendations to address these challenges.

1.3. DESCRIPTION OF AUDIT AREA

1.3.1 General Description

National Water and Sewerage Corporation (NWSC), is a public corporation wholly owned by the Government of Uganda. It currently provides sewerage services to nineteen (19) towns, namely: Kampala, Jinja, Entebbe, Kajansi, Tororo, Mbale, Masaka, Mbarara, Gulu, Lira, FortPortal, Kabale, Kasese, Soroti, Iganga, Malaba, Mukono, Hoima, and Masindi. Sewage management is a broad concept that entails the process of safe collection, transportation, treatment and proper discharge of treated sewage. Management of sewage in Uganda is majorly a responsibility of NWSC. Other stakeholders in this process include: urban authorities, Ministry of Water and Environment (MWE) and Ministry of Health (MOH). NWSC operates and manages the major collection, treatment and discharge infrastructure.

Table 1: Showing sewerage subscribers, connections and treatment plants

S/No	Performance indicators	Units	2011	2012	2013
1	New sewer connections	Numbers	301	301	235
2	Number of Subscribers (sewerage)	Numbers	15,561	17,653	17,888
3	Number of Waste Water Treatment Plants	Numbers	22	22	22

Source: OAG extracts from National water and sewerage corporation Annual report 2012 2013

[5] Kampala Sanitation master Plan Vol.1 page 17

6 Uganda water and Environment Sector performance report 2013. Pg V

[7] Ibid

[8] The central role of waste water management in sustainable development-UNEP report

[9] Waste water production, treatment and use in Uganda-Kayiizi ET al.2012.

1.3.2 Legal Framework and Statutory Mandate

National Water and Sewerage Corporation (NWSC) is a public utility company whose mandate as defined in the National Water and Sewerage Corporation Act 1995, is to operate and provide water and sewerage services in areas entrusted to it under the Water Act[10].

1.3.3 Vision and Mission

Vision: "To be one of the leading water utilities in the world"

Mission: "To provide efficient and cost effective water and sewerage services applying innovative managerial solutions to the delight of our customers"

1.3.4 Objectives

The major objectives of management of sewage by NWSC are:

- To achieve increased sewerage coverage.
- To achieve improved sewage effluent.

1.3.5 Activities carried out by the NWSC

NWSC undertakes the following activities in regard to sewage management:

- Strategic planning for the sewerage services for the areas under the control of NWSC.
- Managing the process of collection, transportation, treatment and discharge of sewage through establishment of sewer network; construction and maintenance of treatment infrastructure across the country; ensuring that the effluent discharged to the environment meets environmental standards.

1.3.6 Organization Structure

Sewage management activities are handled by the Director Planning and Capital Development and the Director Engineering Services. The Director Engineering services is assisted by the operation managers at the regional levels as detailed in the organizational structure attached as **Appendix V.**

1.3.7 Funding

NWSC had spent UGX 10.9billion towards sewage management activities in the areas under its jurisdiction over the last three years as detailed in **Table 2**

[10] National water and sewerage corporation Act (NWSC) Act 1995

Table 2: Showing funding for sewage management activities by NWSC

Period	2011/12	2012/13	2013/14	Total
Amount UGX (Bn) *	2.9	3.5	4.5	10.9

Source: OAG analysis of NWSC sewerage expenditure

* These figures exclude expenditure for Kampala Sanitation Programme

1. 4 AUDIT OBJECTIVES

The overall objective of the audit was to assess the extent to which NWSC has been able to increase the sewerage coverage and improve the quality of effluent discharged.

The specific audit objectives were:

- To assess the extent to which NWSC has ensured that there is adequate access to sewage services by the population in the towns under its jurisdiction and that all generated sewage is collected.
- To assess the extent to which the existing treatment processes facilitate the achievement of quality standards of effluent before discharge to the environment.
- To assess the extent to which NWSC ensures that there is adequate maintenance of the existing infrastructure.
- To assess the adequacy of the existing coordination mechanism between NWSC and other main stakeholders in sewage management.

1.5 AUDIT SCOPE

The audit focused on the activities undertaken by NWSC in regard to extension of sewerage services: collection, treatment, and discharge of effluent, expansion of the sewerage network; and maintenance of existing infrastructure. The audit was carried out at NWSC headquarters coupled with inspection of treatment infrastructure in Kampala, Entebbe, Masaka, Mbarara, Kabale, Fortportal, Masindi, Hoima, Jinja, Mbale and Gulu. The audit focused on three financial years 2011/12, 2012/13 and 2013/14.

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CHAPTER TWO

CHAPTER TWO

AUDIT METHODOLOGY

The audit was conducted in accordance with the International Organisation of Supreme Audit Institutions (INTOSAI) Performance Auditing Standards and the Performance Auditing guidelines prescribed in the Office of the Auditor General (OAG) VFM audit manual. The standards require that the audit be planned in a manner which ensures that an audit of high quality is carried out in an economic, efficient and effective way and in a timely manner.

2.1 SAMPLING

The team reviewed documents for all the 19 (nineteen) centres/towns served with sewerage services by NWSC. However, field visits were conducted in 11 (eleven) towns with the biggest number of customers.

2.2 DATA COLLECTION

The following data collection methods were used to gather evidence:

Audit Objective	Data collection method
• To assess the extent to which NWSC has ensured that there is adequate access to sewage services by the population in the towns under its jurisdiction and that all generated sewage is collected.	The team reviewed documents such as the annual performance reports and active sewage account records to establish the level of access to sewage services. The team also conducted interviews with NWSC staff about network expansion and development.
• To assess the extent to which the existing treatment processes facilitate the achievement of quality standards of effluent before discharge to the environment.	The team interviewed the area managers and quality control officers/ lab technicians at the areas visited. The team also reviewed monthly effluent test results for the different areas visited.
• To assess the extent to which NWSC ensures that there is adequate maintenance of the existing infrastructure.	The team interviewed NWSC Engineers and area managers about the maintenance activities undertaken. The team reviewed monthly maintenance reports and inspected sewage treatment infrastructure to ascertain if there was adequate maintenance.
• To assess the adequacy of the existing coordination mechanism between NWSC and other main stakeholders in sewage management.	The team conducted interviews with area managers and also reviewed correspondences between NWSC and other stakeholders.

Data Analysis

The data obtained was analysed to establish the overall performance of NWSC over the period under review. The team analysed effluent test results to establish the effectiveness of the treatment processes and the efficiency of the sewage treatment infrastructure.

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CHAPTER THREE

CHAPTER THREE

SYSTEMS AND PROCESS DESCRIPTION

3.1 ROLES AND RESPONSIBILITIES OF KEY PLAYERS

There are a number of key stakeholders involved in sewage management in urban areas. These include:

Ministry of Water and Environment (MWE)

The Ministry of Water and Environment is the parent ministry under which NWSC falls. The Ministry, through the Directorate of Water Resource Management, issues discharge permits to National Water and Sewerage Corporation to authorise discharge to the environment in a manner that ensures the environment is not polluted.

National Water and Sewerage Corporation Board

The Board is the overall policy and decision making organ of the corporation and is charged with the responsibility of approving policies, plans and budgets. The board is also charged with ensuring that NWSC performs to the expectation of the stakeholders in achieving its mandate.

Director Planning and Capital Development (NWSC)

The Director Planning and Capital Development, together with the Manager Infrastructure Planning Development under NWSC, is charged with ensuring that there is planning for sewerage projects and that all projects are implemented according to plan. He oversees design and construction of planned sewerage infrastructure. The Director is also charged with soliciting for funding to undertake the various projects aimed at ensuring that the infrastructure targets are achieved.

Director Engineering Services (NWSC)

The major role of the Director Engineering Services is to ensure that the infrastructure remains fully operational. This is done by the regional sewerage managers and engineers through routine maintenance of the existing infrastructure and replacement of parts in the old network. The Director also participates in the process of designing new infrastructure.

National Environment Management Authority (NEMA)

The National Environment Management Authority is a semi-autonomous government body charged with ensuring that the environment is utilised in a sustainable manner. NEMA plays a number of roles in the implementation of sanitation in urban areas.

- Issues licenses to waste handlers
- Ensures that the waste is treated according to approved standards before it is discharged to the environment
- Approves environmental impact assessments before major sanitation projects are undertaken.

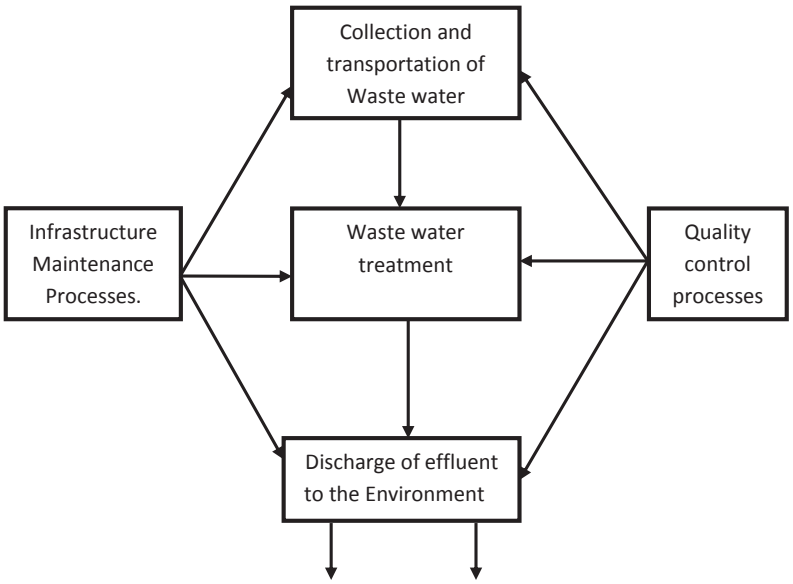
Local Governments

These include mainly Municipalities and Town councils. The local governments are charged with ensuring that residents are served with adequate sewerage services. This is done through coordinated planning and implementation of sewage activities. The local governments are also responsible for physical planning of the areas and as such they plan for sewer networks, and sewage treatment facilities.

3.2 PROCESS DESCRIPTION

There are a number of processes that are undertaken by National Water and Sewerage Corporation in sewage management for the towns under its jurisdiction. The major processes undertaken are highlighted below:

Figure 1: Key processes in sewage management



Planning

Sewage management by NWSC starts with development of both long term and short term plans. These plans detail activities to be undertaken and the timeframe within which NWSC plans to undertake these activities. They also detail the expected targets or outcomes that NWSC intends to achieve by implementing the planned activities and the strategies for the implementation of these activities. The process of planning starts with a review of the previous plans and evaluation of the level of achievement of the previous plans. New plans are then developed based on the available resources. All plans have to be approved by the Board before they are operationalized. Examples of plans developed by NWSC include the KSMP, the Corporate Plan for 2009-2012, 2012-2015, and the Sanitation Plan for towns outside Kampala.

Operational Process

After approval of the plans, NWSC then embarks on implementing these plans in order to achieve the set targets. The key operational process undertaken by NWSC are summarised below:

a) Connection to NWSC Sewer Network.

The process of connecting to the sewer network starts with making an application to NWSC area offices. The sewerage engineer then undertakes a technical evaluation to establish the feasibility and cost of making the extension to the applicant's site. Connection costs depend on a number of factors, however, there are standard connection rates for customers within sixty meters (60m) from the main sewer line approved by NWSC. Currently, NWSC charges the following amounts for the different types of network connections.

- 4 inch connection- 210,000
- 6 inch connection- 262,000
- Over 6 inch connection- 350,000

In cases where the site is located more than sixty meters (60m) from the NWSC main sewer lines, the customer meets the extra costs at a rate per meter determined by NWSC.

b) Collection and transportation of generated sewage

The sewage generated is collected and transported through either the sewer network or by cesspool trucks. For customers connected to NWSC sewers, waste generated flows by gravity through the pipes directly to the treatment facilities. For customers who are not connected to the main sewer network, generated waste is collected in on site sanitation facilities (septic tanks and pits) before it is transported to the treatment points using cesspool trucks.

c) Sewage treatment.

The principle objective of sewage treatment is to allow human and industrial effluents to be degraded and disposed of without danger to human health or un acceptable damage to the natural environment. NWSC uses mainly two methods to treat sewage:

- **Conventional methods-** This consists of a combination of both physical operations and biological processes to degrade and remove solids and harmful nutrients from the sewage.
- **The non-conventional-** This uses biological processes that mainly take place in the stabilization ponds to remove harmful nutrients from the sewage.

Sewage treatment by conventional methods

When the raw sewage reaches the treatment plant, it undergoes preliminary treatment which usually is done by directing the waste water/ raw sewage through a series of screens and strainers to remove any floating materials (for example rugs, plastics, paper, wood and polythen) that may have come along with it.

The sewage is then channelled to sedimentation tanks where it undergoes primary treatment. Primary treatment allows sludge and other heavy solids to settle down and allows light materials, including grease and oils, to rise to the surface where they can be removed through a process known as skimming.

The sewage then undergoes secondary treatment using both aerobic and anaerobic processes. Anaerobic bacteria degrade the sewage by feeding on the nutrients which are dissolved in the absence of oxygen.

The sewage then undergoes aerobic degradation where it is passed over stone or plastic media that is grown with bacteria, algae and other micro-organisms. Aerobic digestion can also be done by passing the sewage in an aeration tank where it is vigorously mixed with air to provide oxygen for aerobic organisms for several hours to allow the bacteria break down the organic material.

After this stage, the sewage undergoes tertiary treatment to continue the purification process before discharge to the environment.

Treatment process by conventional methods involves the use of machines such as: aerators, trickling filters, bio filters.

Sewage treatment using the non-conventional method

Non-conventional methods treat sewage by using mainly stabilization ponds. There are mainly three types of ponds: the anaerobic ponds, facultative and maturation ponds.

Raw sewage is channelled through filters to remove any solid and floating objects before flowing to the anaerobic ponds.

The sewage undergoes anaerobic digestion where anaerobic bacteria feed on the organic nutrients in the absence of oxygen. This process takes 2-3 days and reduces up to 80% of the dissolved nutrients.

After anaerobic treatment, the sewage is then channelled to the facultative pond which has both anaerobic zones (deeper parts in the pond) and aerobic zones (close to the surface) where there is continued degrading of the wastewater water by the bacteria and other microbiological organisms that keep feeding on the contents of the sewage. At this stage, the sewage undergoes both anaerobic and aerobic processes which help further degrade the sewage. This process usually takes 5-10 days.

The final sewage treatment process is maturation and takes place in the maturation ponds. The maturation process is aimed at killing and removing the anaerobic and aerobic bacteria including any other pathogens before final discharge to the environment.

d) Effluent discharge to the environment

Once the sewage has undergone treatment it is discharged to the environment. Discharge is usually into wetlands for continued purification before joining major water sources. The method of discharge and quality of the effluent must meet the discharge standards set out in the discharge permits granted and other environmental regulations in place to avoid pollution of the environment and contamination of potential water sources.

e) Quality control

This process involves all activities aimed at ensuring that the quality of whatever is discharged to the environment meets quality parameters and is of no harm.

Controlling the quality of influent into the ponds involves conducting regular checks on the sewage from the main sewer lines and conducting of quality tests on the raw sewage delivered by cesspool trucks to ensure that what is delivered will not affect the treatment process.

During the treatment process samples from different ponds at different treatment stages are taken to confirm if treatment infrastructure is effectively operating.

Upstream (before the point of discharge) tests are done to ascertain the characteristics of the water before effluent is discharged into environment. Downstream (after point of discharge) tests on the other hand are done to assess the impact of the discharged effluent into the water source.

Quality tests are also done on a monthly basis on the effluent that is being discharged to the environment to confirm if the discharge meets national standards for the various parameters before it is discharged to the environment. Examples of parameters tested include: Chemical Oxygen demand (COD), Biological Oxygen Demand (BOD), Total Suspended solids (TSS).

f) Maintenance of the sewerage infrastructure

Sewerage infrastructure includes: the sewer pipes, stabilization/ponds, treatment plants and any other infrastructure that is used to collect, transport, treat and discharge the generated sewage.

The Director engineering services is responsible for ensuring that this entire

infrastructure remains operational through routine maintenance and servicing. Major maintenance activities include: regular flushing of the sewer pipes, desludging of the ponds, replacement of non-functional network parts, for example, network pipes; replacement of aging network parts; and servicing of equipment at treatment plants. This is done routinely to avoid complete breakdown of the infrastructure.

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CHAPTER FOUR

CHAPTER FOUR

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

National Water and Sewerage Corporation (NWSC) has taken steps to ensure effective management of sewage in its ambit of operation. Some of the steps taken include: developing both short and long term plans aimed at addressing sewage management challenges, and ensuring regular monitoring of effluent quality through conducting monthly effluent tests. The sewage treatment infrastructure in the areas of Entebbe and Kabale were also well-maintained. However, there are still areas that need improvement if the NWSC waste management objectives are to be achieved.

4.1 ACCESS TO SEWERAGE SERVICES

According to the approved NWSC Corporate Plan 2012-2015[11]-, one of the major sewerage goals is to increase accessibility to sewerage services and increase the volume of sewage collected and treated. This was to be achieved through a number of strategies, including: exploring the use of condominium approach to service delivery of sewage services among low income earners, developing and implementing an effective sewerage service demand creation programme, mobilising funds for sewerage infrastructure in and outside Kampala, and carrying out a well-planned sewer network expansion.

It was noted that NWSC has taken steps to improve sewerage access such as: securing funding from African Development Bank (AFDB), Kreditanstalt für Wiederaufbau (KfW), European Union (EU) and the Government of Uganda (GOU) to develop the Kampala Sanitation Master Plan and Strategy Phase I; conducting a feasibility study in 2008 from which NWSC mapped Kampala into drainage areas, where on-site sanitation and sewerage systems could be developed; implementing the Kampala Sanitation Programme 1(KSP1) to improve sewerage infrastructure within Kampala; and securing funding towards the financing of sewerage infrastructure in Arua, Gulu, Mbale, Kasese, FortPortal, Masaka, Mbarara and Bushenyi.

Despite these efforts, however, access to sewerage services in most urban centres is still low and has not significantly improved over time. NWSC has targeted to have all its customers with water accounts also served with sewerage services. Interviews and review of the annual performance reports revealed that of the total population of customers with water accounts, only 6.4% and 6.7% had access to sewerage services for the years 2011/12 and 2012/2013, respectively as shown in **Table 3** below. Access of the population to the sewer network in each town is shown in **Appendix V.**

[11] Page 55 of the Corporate Plan for 2012-2015

Table 3: Showing percentage of the population served (sewerage)

Period	2011/12	2012/13	2013/14
% of population served Coverage	6.4	6.7	*

Source; NWSC annual performance reports 2011/12 and 2012/13 (*figures for 2013/14 were not yet published by the time of the audit).

Management attributed the low levels of access to the fact that the NWSC tariff is not a cost recovery tariff to support the desired infrastructure growth and the fact that development partners who are the main financiers of major infrastructure projects prefer to support water infrastructure development which has a better rate of return on investment. This is compounded by the fact that most domestic users prefer to use on site sanitation like septic tanks, Ventilated Improved Pit (VIP) latrines as opposed to connecting to NWSC system which is considered expensive by the majority of customers.

We also noted that the strategies proposed to increase sewerage coverage in the 2012-2015 Corporate Plan had been partly implemented. **Table 4** below details the status of implementation of the proposed strategies aimed at increasing sewerage coverage.

Table 4: Showing implementation of strategies by NWSC to increase sewerage coverage

Proposed Strategy	Status of Implementation	Auditors Comment
Implement the recommendations of the tariff study in relation to sewerage services. The tariff study recommended an increase of the sewerage tariff by 20%	Not implemented because the sewage coverage is still low and thus would not make economic use. However, raising the sewerage coverage to about 30-40% would bring down the sewerage tariff to a level comparable to the existing tariff; in this regard major sewage infrastructure projects are ongoing and once completed a wider revenue base will be realised.	This strategy was aimed at ensuring that the tariff charged is a cost recovery tariff. However, this is yet to be implemented.
Raise sewerage service profile through uplifting the institutional setup of the department	The NWSC restructuring exercise has commenced and it is planned that the Sewerage Service Department will be elevated to a distinct department headed by a General Manager. This will give the sewerage management the attention it requires.	Raising the profile of the department was aimed at ensuring that the sewerage department gets human and other resources to achieve the set sewerage targets. The new structure had not yet been operationalized by the time of the audit.
Explore the use of condominium approach in delivery of sewerage services among low income earners	The piloting of the use of UGAVACs for collection and transportation of sewage from informal settlements was completed. The consultant has now been engaged to design facilities for upscaling in 42 selected parishes within Kampala targeting up to 250,000 persons for improved sanitation.	Although the piloting of the use of UGAVACs was completed, this strategy is yet to be implemented in Kampala and in other towns outside Kampala.
Develop and implement an effective sewerage service demand creation programme	NWSC is currently implementing an infrastructure service delivery program (ISDP) aimed at expanding the infrastructure and improving the service delivery. The program has been rolled over all operation areas.	

Mobilise funds for sewerage infrastructure development in other areas outside Kampala	Funds have been mobilized from Kfw, AfDB, World Bank and GoU towards implementation of sewerage infrastructure in Kampala, Masaka, Mbarara, Gulu, Arua, Mbale, Kasese, Bushenyi and Fortportal. These projects are at different stages of implementation.	
Carry out well-planned sewer network expansion programmes.	There is a sewer network expansion project going on in Kampala and it is expected to cover 30km of pipe installations. There are various planned projects in other towns as well, in addition to the implementation of the ISDP.	

Source: NWSC corporate Plan 2012-2015

Low access to the sewerage network may result into raw or partially treated sewage being discharged into the environment. Although data was not availed to enable a comparison of the volume of sewage generated in the different towns and the volume of sewage collected and treated by NWSC, a study conducted by Mott Macdonald on behalf of NWSC in December 2012 estimated that by 2014, a total of 238.9 ML of wastewater would be generated (Refer to **Appendix VI (a)** for detailed analysis), of which only 8.38ML would be collected and treated. This leaves approximately 230.52 ML of generated sewage uncollected and therefore not treated. (Refer to **Appendix VI (b)**

Management response

In the past, there has been a deliberate strategy to emphasise water supply infrastructure expansion compared to sewerage infrastructure development. This was because NWSC has been largely dependent on donor funding for major infrastructure investments and the Development partners preferred to support water infrastructure developments, which have a better rate of return on investment which caused a mismatch between water and sewerage infrastructure development in some of the operation areas.

It is also important to note that sewage systems are not the only acceptable safe methods of sewage treatment and disposal. There are other alternative on site sanitation methods widely used.

Audit Comment

Although NWSC has undertaken some interventions to increase access to sewerage services, especially within Kampala, there is still need for more interventions, especially in areas outside Kampala. Access to sewerage services in NWSC operation areas outside Kampala is still low and this negatively affects the ability of NWSC to ensure that all the sewage generated is adequately collected and treated.

Recommendation

Since access to sewerage services is a key aspect of sewage management, there is need to implement the proposed strategies to ensure increased access. NWSC should expedite restructuring of the Sewerage Services Department and the on-going network expansion projects, and explore the use of the condominium approach in delivery of sewerage services among low income earners.

4.2 QUALITY OF THE EFFLUENT DISCHARGED

The National Environmental (Standards for discharge of effluent into water or on land) Regulations, 1999 state the maximum permissible limits for discharge of effluent or waste water.

Review of the annual performance reports for 2012 and 2013 revealed that the effluent discharged by NWSC to the environment did not meet the national effluent quality standards set by NEMA. A summary of the achievement of the discharge standards by NWSC is summarised in **Table 5** below.

Table 5: Showing compliance with effluent standards

Parameter analysed	National Standard	Compliance level achieved 2011/12	Compliance level achieved 2012/13
Biochemical Oxygen Demand (BOD)	50mg/l	29.3%	37.6%
Total Suspended Solids (TSS)	100mg/l	52.1%	47.7%
Feacal Coliforms	10,000CFU/ 100ml	70%	0

Source: NWSC Annual performance reports for 2012 and 2013

Further analysis of sample monthly test results conducted by NWSC on the quality of effluent discharged from the areas visited confirmed that the effluent consistently failed to meet the ten quality parameters set by the national standards as detailed in **Appendix VII**. This is an indication that there are inefficiencies in the treatment processes that have persisted over time.

Out of these quality parameters, an analysis was made using three key parameters to ascertain the extent to which the treatment processes of NWSC met the effluent quality standards as shown below.

- **Bacteriological Feacal coliforms. (BFC)**

The presence of Bacteriological Feacal coliforms (BFC) in sewage is an indicator of the potential presence of disease causing organisms. The National Environmental standard set for any sewage effluent discharged is a maximum of 10,000CFU/100ml. However, review of the test results indicated that in some cases, the level of BFC in the effluent

discharged was way beyond the maximum accepted limit as shown in **Table 6** below:

Table 6: Showing cases where amount of BFC was excessive

Month/Period	Amount of coliforms reported (CFU/100ml)	Area
June 2013	1,930,000	Bugolobi (Kampala)
December 2013	15,360,000	Bugolobi (Kampala)
March 2014	20,000,000	Bugolobi (Kampala)
June 2013	7,000,000	Doko ponds (Mbale)
June 2013	5,000,000	Namatala ponds (Mbale)
March 2012	1,440,000	Kizungu ponds (Mbarara)
March 2012	1,080,000	Katete Ponds (Mbarara)

Source: OAG analysis of NWSC effluent results

The average level of BFC over the three years under review was also found to be high in four other areas visited as summarised **Table 7** below:

Table 7: Average BFC in effluent discharged by NWSC over a three year period 2011/12, 2012/13 and 2013/14

Area Visited	Average level of BFC	National Standard	Variance from the National Standard
Entebbe	77,483	10,000	67,483
Fortportal	10,500	10,000	500
Hoima	44,260	10,000	34,260
Gulu	104,464	10,000	94,464

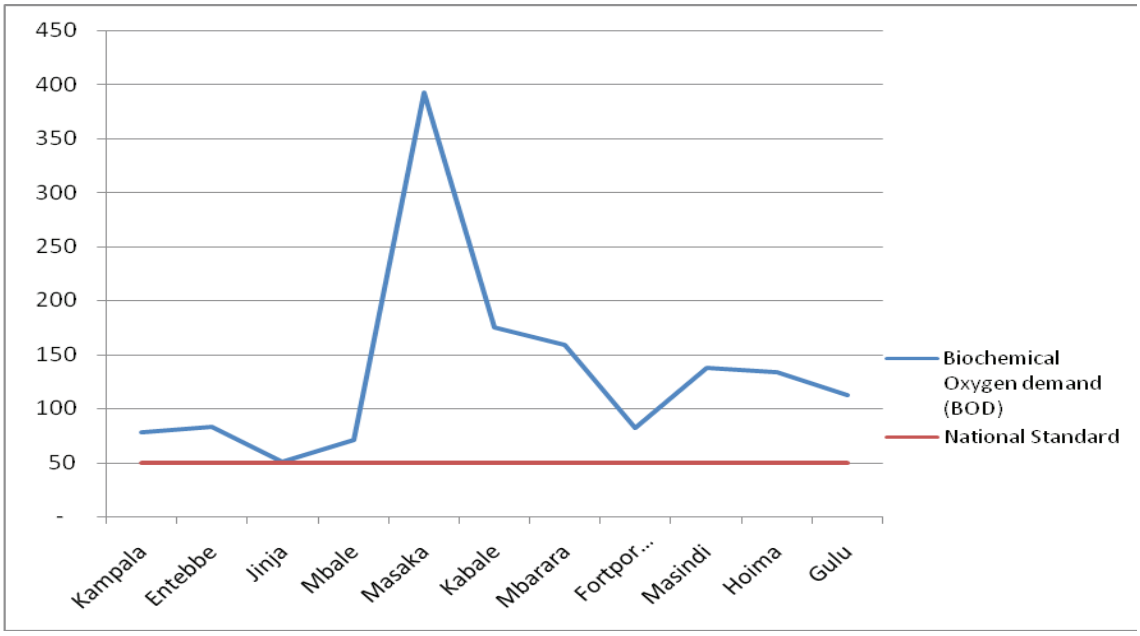
Source: OAG analysis of NWSC effluent results

- **Biological Oxygen Demand (BOD)**

BOD is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material. Discharge of effluent with high BOD levels (higher than 50mg/l) results in depletion of dissolved oxygen available for aquatic life in the receiving streams/rivers, which affects survival of fish and other aquatic life.

Effluent analysis from all the places visited indicated that the average BOD levels in effluent discharged was above the recommended limit as shown in **Figure 1** below:

Figure 2: Showing average BOD in effluent discharged by NWSC

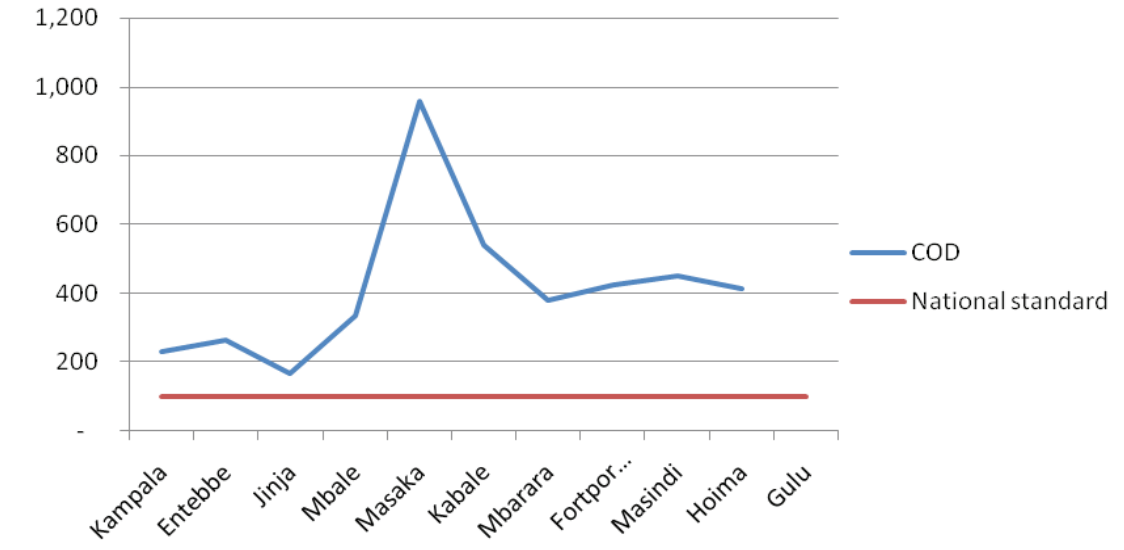


Source: OAG analysis of BOD levels in effluent discharged for the period review.

- **Chemical Oxygen Demand (COD)**

This is the measure of organic compounds and pollutants in the water. The national standard for the maximum permissible limit of COD in waste water is 100mg/l. From the data availed the team established that the average COD level in the effluent discharged by NWSC was above the permissible limit in all the areas visited as shown in **Figure 3** below which indicated that the effluent still contained a high level of pollutants at the time of discharge.

Figure 3: Showing average COD in discharged effluent



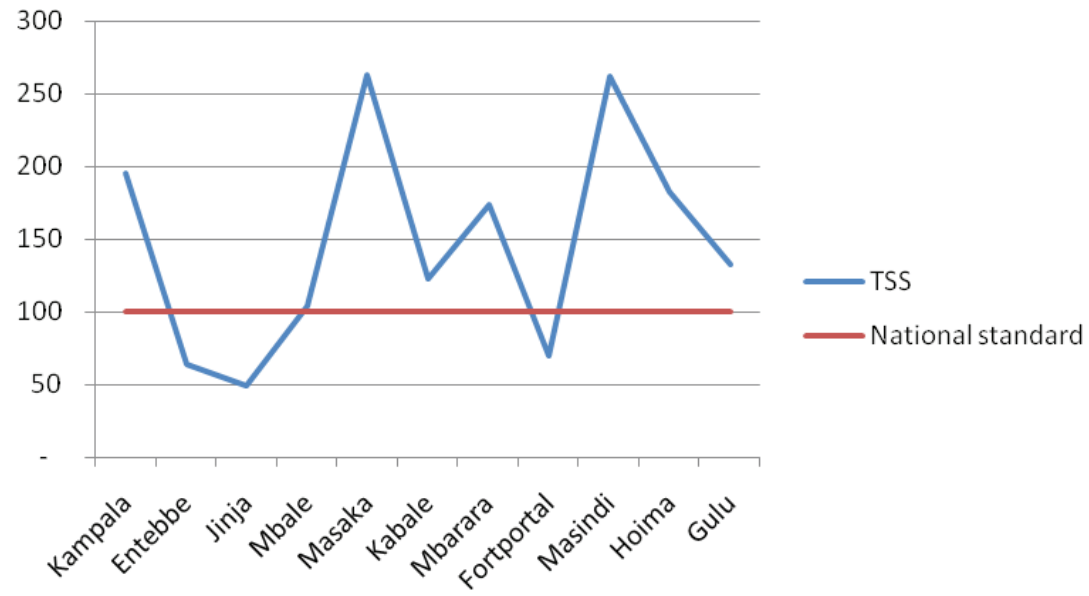
Source OAG analysis of COD levels in effluent discharged for the period reviewed

- **Total suspended solids (TSS)**

Total suspended solids (TSS) include all particles suspended in the sewage. The national standard for the maximum permissible limit of TSS in waste water is 100mg/l. A high concentration of suspended solids reduces the light penetration into the water and leads to increased temperatures of the water which all negatively affect aquatic life.

The level of TSS for the effluent discharged by NWSC in the areas visited was noted to be generally high as shown in **Figure 4**, which poses a threat to the environment.

Figure 4: Showing average TSS in the effluent discharged



Source: OAG analysis of average levels of TSS in the effluent discharged

From interviews conducted with the various area managers and sewerage engineers, failure to meet national standards was partly attributed to ponds operating beyond design capacity. In other instances, failure to meet the national standards was attributed to irregular desludging of ponds, and absence of stringent controls to ensure that poor quality influent did not get into the ponds. All these have affected the operational efficiency of the sewage treatment infrastructure and thus quality of the effluent. A case in point is the Katete ponds in Mbarara where a pink substance as shown in **Picture 1** was observed in the anaerobic pond which was an indicator of illegal substances.

Picture 1: Section of Katete ponds in Mbarara covered with an alien substance

Purple/pinkish instead of the normal colour (grey) which, according to pond managers, is an indicator of illegal substance discharged

Source: OAG inspection photographs taken on 21/11/2014

Using the data that was availed (for Kampala, Mbale, Masaka, and Mbarara), an analysis of the quality of the water at the upstream points (before discharge points) and the quality of water at the downstream points (after discharge point) as shown in **Table 8**, indicated that the water was more polluted after discharge of the effluent. (Refer to **Appendix VIII** for details)

Table 8: Quality of water at upstream and downstream points

Area	Parameters	Average upstream level	Average downstream levels	Comments
KAMPALA	BOD	Not done (ND)	ND	The level of BOD, COD, EC and TSS is higher in the water downstream, an indicator of possible pollution by the effluent discharged.
	COD	202.5	338	
	Electro conductivity (EC)	610	784	
	TSS	169	336	
MBALE	BOD	43.7	67.5	The level of BOD, COD and TSS is higher in the water downstream, an indicator of possible pollution by the effluent discharged.
	COD	55.2	202	
	EC	3284	3215	
	TSS	37	42	
MASAKA	BOD	45.5	32	EC is higher downstream indicating possible pollution by effluent discharged.
	COD	111	81	
	EC	440	600	
	TSS	21	19	
MBARARA	BOD	18.6	24	The level of BOD, COD, EC and TSS is higher downstream an indicator of possible pollution by the effluent discharged.
	COD	88	90	
	EC	1269	1358	
	TSS	8	17	

Source: OAG analysis of quality of water at upstream and downstream points

Management response

The conventional technological treatment process used by NWSC cannot meet national standards, which are stringent. For instance, the removal of Nitrogen and Phosphates cannot be achieved using the current technologies. NWSC shall require additional investments in advanced waste water treatment technologies to address this challenge. However, the rest of the effluent parameters such BOD, COD, TSS, E-Coli, PH can be achieved to acceptable standards. NWSC also has a well-equipped laboratory to monitor the quality of the effluents before final discharge to open environment. A new state of the art laboratory is being constructed in Bugolobi and there are plans to also construct regional laboratories to support the operation areas.

All the waste water generated at household level, industrial and institutional premises are supposed to be measured upon delivery to the NWSC treatment facilities using various methods (bucket method, venture flume and weirs are commonly used). However, these methods are obsolete and involve physical handling of hazardous material. With emerging technologies, NWSC has plans to procure modern instruments to appropriately carry out measurements of waste discharged at the various sewerage plants in the operation areas.

There are also other mechanisms applicable, whereby population estimates obtained from UBOS are used to estimate the waste water volumes generated per household.

Audit Comment

NWSC is one of the major dischargers of effluent into the environment therefore its consistent non-adherence to the national standards set by the NEMA, which is the government organ charged with setting up and ensuring enforcement of environment standards, may send a wrong message to the other dischargers of effluent. Where NWSC has justifiable reason not to meet the standards, all relevant stakeholders namely: Ministry of Water & Environment, NEMA and other government organs should be engaged to address the challenges.

Failure to meet quality standards for the effluent discharged is an indication that the treatment process of the sewage collected by NWSC is not effective in ensuring quality discharge of effluent which poses a threat to both the environment and human life.

Recommendations

- Although there are plans to make additional investments in advanced sewage treatment technologies, management should implement measures to enhance the operational efficiency of the treatment infrastructure by strengthening controls to ensure that the influent discharged into the ponds meets standards, and undertake regular desludging of the ponds to facilitate efficiency of the treatment process.
- To ensure that the quality of influent is monitored, NWSC should conduct regular checks on the sewage source. This will help identify areas and sources with high risk influents.

4.3 EFFLUENT DISCHARGE PERMISSION

Section 28(2)(a) of the Water Act states that a person who is responsible for the production, storage, discharge or deposit of any waste shall not cause or permit any waste to be discharged directly or indirectly into any water, except in accordance with a waste discharge permit.

The discharge permits issued set out conditions and terms that must be adhered to to ensure that the waste discharged and the manner in which it is discharged does not pollute the environment, and cause health risks to the population.

The audit team observed that for the period under review (FY 2011/12 to 2013/2014), NWSC discharged effluent to the environment without a discharge permit. The last discharge permit issued to NWSC expired on 25th of May 2009.

Without discharge permits it is not possible to monitor if NWSC is discharging effluent in a manner and form that is not harmful to the environment. NWSC, for example, cannot ensure that the volume and quality of its discharge can be handled by the surrounding wetlands without causing risks to the environment.

It also becomes difficult for other key stakeholders especially monitoring agencies namely MWE and NEMA to ensure that effluent is properly discharged since there is no basis for monitoring.

Management response
NWSC periodically applies and pays for renewal of discharge permits. The last discharge permits payment was processed on the 2nd June 2014, for a period of three years (2009 to 2014). Valid discharge permits are being processed by the Directorate of Water resources Management.

Audit Comment

The date of payment for the discharge permits of June 2014 shows that NWSC delayed to renew the discharge permit by almost four years.

Without discharge permits it becomes hard to ensure that effluent is discharged in a manner that will not affect the environment and pose other health risks.

Recommendation
The management of NWSC should ensure that they obtain valid discharge permits from the Ministry of Water and Environment Directorate of Water Development, in a timely manner and comply with the conditions set therein.

4.4 MAINTENANCE OF TREATMENT INFRASTRUCTURE

4.4.1 Inspection of the Treatment Infrastructure

According to the Corporate Plan 2012-2015, NWSC set out to ensure efficient service delivery through an extensive proactive programme for maintenance of Waste Water Treatment Plant (WWTP) to improve compliance with treatment standards, rehabilitation of critical sewer network and WWTP and use of innovative approaches to de-sludge lagoons in all areas as a measure to further improve the quality of effluent discharged.[12]

During inspections, the audit team noted that out of the fourteen (14) sets of stabilization ponds inspected in the different towns, four (4) sets of ponds for Bugolobi, Kabale, Gulu and Entebbe were visually well maintained. However, for the other 10 (ten) sets, the amount of sludge visible in some of the ponds appeared to have been built up over a long period of time.

In Mbarara, overgrown bushes were observed at Kakoba ponds, while in Masaka the motor of one of the aerators had been non-functional for close to ten months at the time of the audit. In Jinja, large volumes of sludge were visible in the facultative ponds resulting in "channelled flow" of the sewage. In other places, ponds, especially the anaerobic ponds, were full of sludge and polythene and rubbish were visible on the surface of the ponds as shown in **Appendix X.**

In Kabale, it was noted that a section of the sewer line was blocked and only fastened with polythene "kaveera" material as shown in **Picture 2** below. This resulted in frequent cases of leakage of raw sewage directly to the environment.

[12] Corporate Plan-July01, 2012-June 30,-2015; page 61

Picture 2: Section of the sewer line to Kabale Ponds

A section of the sewer pipe to the Kabale ponds fastened with polythene wire showing leakages of raw sewage to the environment.

Source: OAG photograph taken on 20/11/2014

The poorly maintained infrastructure was partly caused by weaknesses in monitoring and supervision. In other cases, management attributed it to the current method of desludging which is manual and includes the use of spades and buckets. This method is not user-friendly due to health hazards associated with physical handling of faecal matter. Siltation of the ponds is also exuberated by the ingress of the storm water into the sewer system, through vandalised manhole covers.

Management response

Routine maintenance of waste water treatment plants is a standard operation routine. Each operation area has a budget for maintenance activities for all NWSC infrastructure, including waste water plants. Non adherence of some operation areas to undertaking these activities usually calls for disciplinary measures.

Regular and satisfactory desludging requires application of sophisticated and expensive technology such as floating remote controlled dredger equipment. NWSC with financial support from the World Bank is in the process of procuring the required equipment which will be used in all the NWSC operation areas for desludging of the stabilization ponds.

The current fencing for the NWSC facilities has been mainly the use of chain link with steel poles. These were easily vandalized and stolen. However, we have adopted the use of plant hedges which are considered permanent, compared to chain link.

Audit Comment

Maintenance of the existing sewage treatment infrastructure is still inadequate and this affects the effectiveness of the treatment process of the sewage collected, and the life span of the treatment infrastructure.

Recommendations

- NWSC should liaise with local governments to ensure that there is adequate storm water management to prevent ingress into the sewer system.
- Management should expedite the process of procuring better equipment to ensure that all areas of operation carry out satisfactory maintenance and desludging of the stabilization ponds.
- Management should further enhance its monitoring of upcountry areas to ensure that desludging is done on a regular basis as is required and budgeted for.

4.4.2 Maintenance of operational records/data

Section 77 (1)(a) of the National Environment Act requires that any person who carries on any activity which has or is likely to have a significant impact on the environment shall keep records relating to the amount of waste and by-products generated by the activity.

Through review of documents, it was noted that NWSC had monthly summaries of flow measurement of waste water. However, we were not availed the daily flow data to back up the summaries. The records relating to the volume of effluent discharged to the environment, the volume of sewage handled by the treatment ponds and the quality of influent into the ponds was also not availed.

Without up to date operational data, it becomes difficult and in some cases impossible to evaluate the performance of the infrastructure and identify factors that may compromise the effectiveness of the infrastructure. For example, lack of information about the volume and flow rate of the sewage exposes the ponds to overload while lack of information about the source of influent exposes the ponds to illegal discharges which affect the performance of the ponds. It also affects effective planning by NWSC for future sewage management interventions.

Management response

NWSC has functional laboratories in the areas of operation. The operation areas are supported by the central lab in Kampala in cases where they may have limitations.

However, there are challenges in the different operation areas related to data collection, which in some cases is based on the obsolete methods used for measuring waste water flows to the plant.

The raw waste water is sampled at the plant and transported to Kampala for analysis; the long distance of transportation also has effect on the quality of the test results. NWSC management plans to acquire user-friendly and modern instruments and laboratory equipment for various stations in due course.

Recommendation

NWSC should put in place measures to ensure that operational data and records are kept and regularly maintained to facilitate operation and maintenance of infrastructure. These measures could include putting in place registers of approved cesspool service emptiers, registers for trucks dumping sewage at the treatment ponds, and measurement devices to measure flow of sewage into and out of the ponds.

4.5 ENGAGEMENT AND COORDINATION WITH OTHER STAKEHOLDERS

Engagement with various stakeholder groups is essential for successful collection and treatment of all generated sewage. Coordination creates the link between the different activities undertaken by various stakeholders to achieve the broader sanitation objectives.

Through interviews with NWSC branch heads and Municipal officials of various municipalities, it was established that there is a coordination mechanism through water committees where NWSC officials hold regular meetings with Municipal officials. This, however, has not resulted in effective levels of coordination.

Inspection of Kizungu ponds in Mbarara and the stabilization ponds in FortPortal showed a number of illegal developments around the pond areas which implies ineffective coordination between NWSC and the urban authorities.

In Mbale, the Municipal Council had approved developments on top of the Mbale main sewer line. Despite instructions in March 2011 to have these developments demolished under the supervision and to the satisfaction of NWSC, by 8th August 2014, this had not been implemented.

In a related development, review of correspondences between NWSC and Mbale Municipal Council revealed that Mbale Municipal Council approved developments along the sanitary corridor behind Kumi Road next to North Road Primary school, and along another sanitary corridor between Bishop Wasikye Road and Maluku Road.

Despite written objections to Mbale Municipal Council, the correspondences reviewed indicated that construction had not stopped. In response, Mbale Municipal council stated that prior to approval of the plans, the Physical planning committee had published a notice in the New Vision Newspaper of 8th November 2011, inviting representations or any objections to the proposed development. No objection was, however, received from NWSC.

It was also noted that NWSC lacks vital information about the treatment infrastructure that is in place. This includes the design life, design capacity and design flow of treatment ponds in Hoima, Masindi, Kabale, Mbale, Mbarara, Gulu and Fortportal. This infrastructure was constructed by the Ministry of Water and Environment and handed over to NWSC without some of this vital information. There was no evidence that NWSC had engaged the Ministry of Water officials to obtain this vital operational information.

Management response

NWSC has water committees in each of the operation areas and this committee comprises local leaders, representatives of communities and other key stakeholders. The committee helps in addressing the water/sewage related issues affecting the communities served.

In Kampala we have initiated water and sanitation clubs in schools and it is planned to upscale this initiative to all other operation areas.

In broader sense, NWSC participates in the water/sanitation sector working groups, engages development partners and leaders at different levels from time to time.

Audit Comment

Although there are areas through which NWSC engages with other stakeholders to achieve better levels of sewage management, these collaborations need to be strengthened to ensure that sewage management objectives are achieved.

Recommendation

NWSC should endeavour to enhance/ strengthen coordination with other key stakeholders to ensure achievement of improved sewage management in the operation areas.

OVERALL CONCLUSION

Although NWSC has undertaken some interventions to increase access to sewerage services, especially within Kampala, there is still need for more interventions, especially in areas outside Kampala. Access of the total population served by NWSC to sewerage services is still low- it stood at 6.7% in 2012/13 and this negatively affects the ability of NWSC to ensure that all the sewage generated is adequately collected and treated. With the current treatment process, NWSC cannot meet some of the quality national standards required for effluent discharged to the environment, which poses a threat to both the environment and human life. Maintenance of the existing waste water treatment infrastructure is still inadequate and this affects the effectiveness of the treatment process of the waste water collected, and the life span of the treatment infrastructure. Without up to date operational data, it becomes difficult and in some cases impossible to evaluate the performance of the infrastructure and identify factors that may compromise the effectiveness of the infrastructure.

NWSC thus needs to expedite ongoing interventions to further improve sewage management.

GLOSSARY OF TERMS

Aerobic digestion	Is a natural biological degradation and purification process in which bacteria that thrives on oxygen rich environment breakdown and digest waste.
Anaerobic digestion	Is a natural process where micro-organisms that thrive in oxygen free environment break down and purify waste in the absence of oxygen
Biochemical oxygen demand	Is the amount of dissolved oxygen needed by aerobic biological organism in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period
Chemical oxygen demand	A measure of organic compounds and pollutants in water
Effluent	This is the final product of earlier sewage treatment processes that is discharged to the environment.
Influent	Raw sewage/wastewater from the sewer system and cesspool trucks that enters the treatment ponds/plant.
Maturation	Is the process by which ponds provide additional treatment to the sewage in the presence of oxygen and sunlight to further reduce pollutants and pathogens before discharge.
Sanitation	Is the hygienic means of promoting health through prevention of human contact with hazards of wastes as well as the treatment and proper disposal of sewage wastewater
Sewage	Is the sub set of waste water that is contaminated with faeces and urine. It includes domestic, municipal and industrial liquid waste and is usually disposed off via a sewer or cesspool emptier.
Sewerage	Infrastructure that conveys the sewage.
Stabilization ponds	Are large man made water bodies in which sewage is treated by natural occurring processes and the influence of solar light, wind and microorganisms.
UGAVACs	Small mobile sewage emptiers pulled by a motor cycle.
Waste water	Is water that has been adversely affected in quality by effects of human influence. It includes water that has been used for washing, flushing and manufacturing and so contains waste products.

APPENDICES

APPENDIX I: Documents reviewed

S/N	Document	Purpose
1.	Kampala Sanitation Master Plan	• To under the sanitation background for the Kampala area and the strategies NWSC had in place to improve the sanitation in areas in and around Kampala. • To understand the challenges faced by NWSC in achieving sanitation objectives.
2.	NWSC Strategic Plans 2009-2012 and 2012-2015.	• To establish the long and short term sanitation goals for NWSC and the strategies for achieving these goals.
3.	NWSC Annual Reports (2011/12, 2012/13 & 2013/14)	• To evaluate the performance of NWSC in achieving its annual objectives • To understand the reasons for failure in cases where the objectives were not met.
4.	The Water Act	• To establish and understand the legal frame work for implementation of sanitation activities by NWSC
5.	NWSC act	• To establish and understand the legal background of NWSC and the mandate of NWSC regarding sanitation activities.
6.	Quality test results on effluent	• To establish the level of compliance of the effluent with quality levels as set out by NEMA.
7.	Effluent Discharge Regulations	• To establish the standards for the different discharge parameters for effluent discharges to the environment
8	Audited financial statements for the period under review	• To establish expenditure incurred by NWSC towards extension of sewerage services.

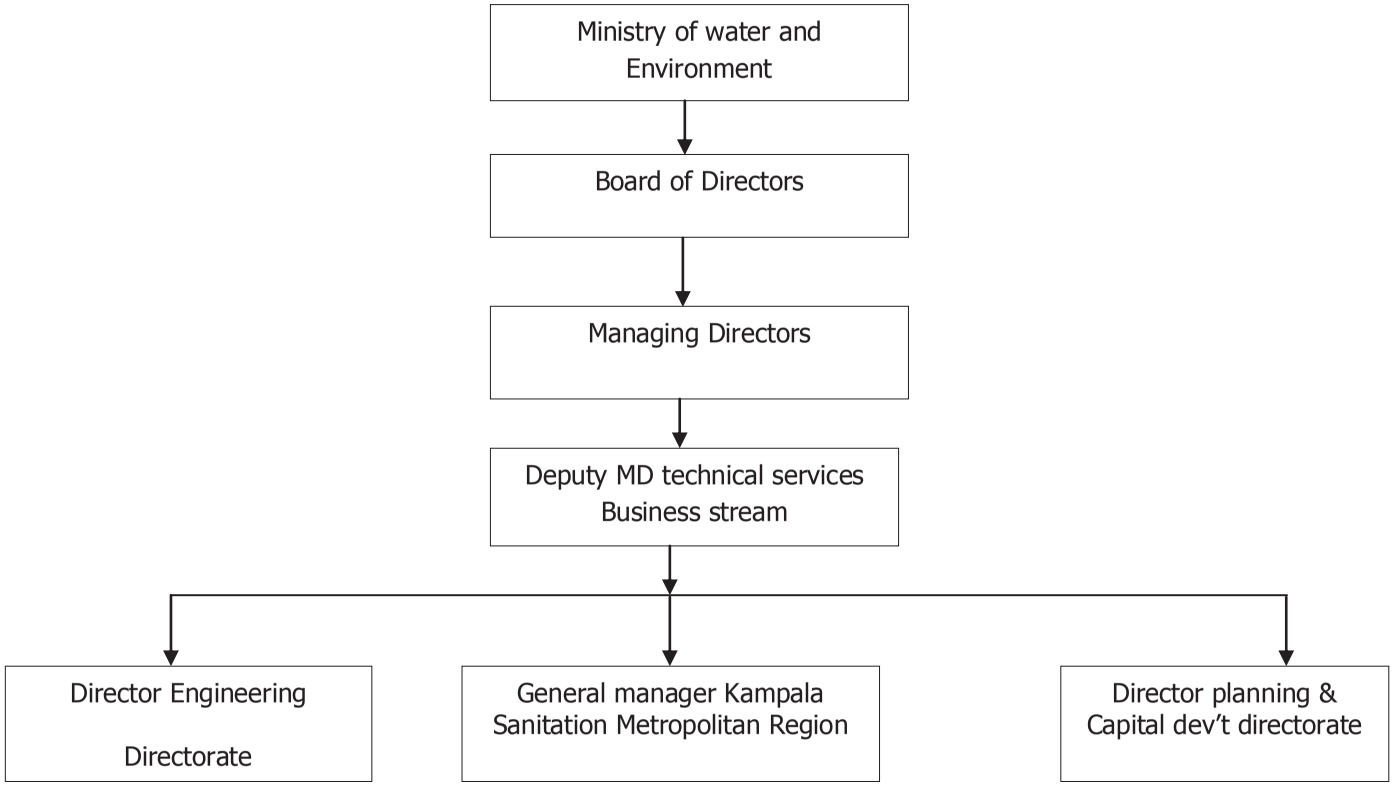
APPENDIX II: Interviews conducted

	Designation	Purpose of the Interviews
1	Director Engineering Services	• To get a deeper understanding of the sanitation activities undertaken by NWSC. • To understand the major challenges facing NWSC in the implementation of urban sanitation • To understand the major stake holders and processes in the process of implementing urban sanitation
2	NWSC Projects coordinator	• To ascertain the major projects that have been undertaken by NWSC in the recent past to improve sanitation • To understand the challenges faced in implementing these projects • To evaluate the impact of the projects that have so far been implemented
3	Area managers and Sewerage Engineers for the 11 visited areas.	• To understand the sanitation activities major stakeholders and process of implementing urban sanitation
4	Municipal engineers for Mbale, Mbarara, Fortportal, and Jinja	• To establish the role of the urban authority in implementing urban sanitation and how they coordinate with NWSC.

APPENDIX III: Sites visited

Site	Location	Reason for the visit
Bugolobi sewerage treatment works	Bugolobi	To conduct a physical inspection of the state of the sewerage infrastructure and to understand the operational processes at Bugolobi treatment plant.
Sewerage ponds in Naalya, Gulu, Mbale (02), Jinja, Mbarara (03), Kabale, Masindi, Hoima, Fortportal, and Entebbe.		To establish the operational state of the stabilization ponds and get a deeper understanding of the process of waste treatment.

APPENDIX IV: Organogram



APPENDIX V: Access to NWSC sewer network as at June 2013*

Area	Sewerage Service Coverage
Kampala/Mukono	5%
Jinja/	22%
Entebbe/Kajansi	4%
Tororo/Malaba	7%
Mbale	26%
Mbarara	8%
Masaka	5%
Lira	2%
Gulu	7%
Kasese	2%
Fort Portal	2%
Kabale	11%
Arua	0%
Bushenyi/Ishaka	0%
Soroti	2%
Hoima	2.5%
Masindi	3.7%
Mubende	0%
Lugazi	0%
Iganga	0.4%
Total	6.7%

Source: NWSC annual performance report 2012/2013. * By the time of audit the 2013/14 statistics were not yet published by NWSC.

APPENDIX VI: Projected Waste water Volume:

AREA/YEAR	2011	2012	2013	2014
Kampala	142.7	156	162.3	168.8
Jinja	9.8	10.5	10.9	11.3
Entebbe	8.5	9.3	9.7	10.1
Tororo	2.5	2.6	2.8	2.9
Mbale	3.7	3.9	4	4.2
Mbarara	4.9	5.6	5.8	6
Masaka	3.6	4	4.1	4.3
Lira	4.1	4.5	4.7	4.9
Gulu	2.5	2.6	2.8	2.9
Kasese	2.4	2.6	2.7	2.8
Fortportal	2.5	2.6	2.8	2.9
Kabale	2.4	2.6	2.7	2.8
Arua	2.3	2.4	2.5	2.6
Bushenyi	1.2	1.2	1.3	1.3
Soroti	3.3	3.7	3.9	4
Hoima	1.5	1.6	1.7	1.8
Masindi	1.5	1.6	1.6	1.7
Mubende	1.1	1.3	1.3	1.4
Lugazi	0.7	0.9	0.9	1
Iganga	1.1	1.1	1.2	1.2
Total	**202.3**	**220.6**	**229.7**	**238.9**

Source: Tariff review and affordability study December 2012, Mott MacDonald

Analysis of total waste water collected.

AREA/ YEAR	2011	2012	2013	2014
Kampala	4.4	4.45	4.49	4.54
Jinja	1.77	1.79	1.8	1.82
Entebbe	0.29	0.3	0.3	0.3
Tororo	0.09	0.09	0.09	0.09
Mbale	0.72	0.73	0.74	0.75
Mbarara	0.44	0.44	0.45	0.45
Masaka	0.12	0.12	0.12	0.13
Lira	0.05	0.05	0.05	0.05
Gulu	0.1	0.1	0.1	0.1
Kabale	0.12	0.12	0.12	0.12
Soroti	0.03	0.03	0.03	0.03
Total	**8.13**	**8.22**	**8.29**	**8.38**

Source: Tariff review and affordability study December 2012, NWSC/Mott MacDonald

APPENDIX VII; Results of monthly quality tests done on effluent samples

NR: Not reported

ND: Not Done

KAMPALA AREA (Bugolobi)

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	mg/l	800								560	590	420	260
Ammonia N	mg/l	10.00								68.4	82.4	51.37	17
Bacteriological: Feacal coliforms	mg/l	10000								1,930,000	15,360,000	20,000,000	-
Biochemical Oxygen demand (BOD)	mg/l	50								-	76	111	49
Chemical Oxygen demand (COD)	Mg/l	100								272	152	371	120
Electrical conductivity (EC)	Us/cm	1500								1480	1561	1193	720
Ortho-phosphate	Mg/l	5								16.8	40.1	36.3	14
PH-physical Chemical		6.0-8.0								7.52	7.80	7.46	7.81
Total phosphorus (TP)	**Mg/l**	**10**								**17.9**	**42.7**	**41.4**	**16.06**
Total suspended solids (TSS)	**Mg/l**	**100**								**154**	**169**	**353**	**105**

ENTEBBE AREA

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	mg/l	800	28	160	96		76	244	250	30	276		
Ammonia N	mg/l	10.00	1	0.35	5.25		0.8	8.0	22.5	21.5	34		
Bacteriological: Feacal coliforms	mg/l	10,000	5.3E4	2E2	80		400	ND	-	1220	410000		
Biochemical Oxygen demand (BOD)	mg/l	50	70.40	33	100		25	127.02	183.28	-	48.36		
Chemical Oxygen demand (COD)	Mg/l	100	148	419	188		103	258	558	273.5	150		
Electrical conductivity (EC)	Us/cm	1500	565	531	500		469	814	573	584	760		
Ortho-phosphate	Mg/l	5	6.0	10.5	2.85		9.8	6	22.75	18.5	25.857.6		
PH-physical Chemical		6.0-8.0	7.5	6.78	7.0		6.88	7.68	7.5	7.51	7.6		
Total phosphorus (TP)	**Mg/l**	**10**	**9.0**	**15.5**	**3.86**		**10.2**	**4**	**25.15**	**20.3**	**27.125**		
Total suspended solids (TSS)	**Mg/l**	**100**	**14**	**26**	**12**		**46**	**48**	**159**	**131**	**74**		

JINJA AREA

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	mg/l	800			430	760		420	880	1350			
Ammonia N	mg/l	10.00			5.55	35		45.5	43.25	52			
Bacteriological: Feacal coliforms	mg/l	10000			80	300		-	-	600			
Biochemical Oxygen demand (BOD)	mg/l	50			69.44	23.02		28	83.08	-			
Chemical Oxygen demand (COD)	Mg/l	100			342	88		80	205	115.6			
Electrical conductivity (EC)	Us/cm	1500			1632	2840		2610	3110	2940			
Ortho-phosphate	Mg/l	5			3.195	10.23		27	26.03	19			
PH-physical Chemical		6.0-8.0			7.90	7.86		8.1	7.4	8.1			
Total phosphorus (TP)	**Mg/l**	**10**			**3.22**	**10.53**		**27.8**	**28.98**	**20.9**			
Total suspended solids (TSS)	**Mg/l**	**100**			**11**	**11**		**60**	**66**	**98**			

MBALE AREA

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	mg/l	800	368	230	360		172	220	300	160			
Ammonia N	mg/l	10.00	2	3.5	5.8		4.5	16	17.50	20			
Bacteriological: Feacal coliforms	mg/l	10000	1E2	269.75	6,500		25,000	-	-	5,000,000			
Biochemical Oxygen demand (BOD)	mg/l	50	117.3	93	43.4		75.08	7	91.14	-			
Chemical Oxygen demand (COD)	Mg/l	100	385	-	102		137	24	173.50	1196			
Electrical conductivity (EC)	Us/cm	1500	776	669	7220		496	695	783	667			
Ortho-phosphate	Mg/l	5	2	3	0.71		2.38	3.5	2.88	3.1			
PH-physical Chemical		6.0-8.0	7.9	7.26	7.8		9.34	8.9	8	7.6			
Total phosphorus (TP)	Mg/l	10	5.5	16	1.56		2.55	4.1	10.09	3.9			
Total suspended solids (TSS)	Mg/l	100	121	27	16		160	89	307	11			

MASAKA AREA

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	mg/l	800	690	440	310	700	1410	250	740		976		
Ammonia N	mg/l	10.00	33.5	8.2	15.25	50	2975	116.0	52		240		
Bacteriological: Feacal coliforms	mg/l	10000	-	-	-	-	-	-	-		-		
Biochemical Oxygen demand (BOD)	mg/l	50	166.6	1551	280	207.64	281.12	341	168.64		144		
Chemical Oxygen demand (COD)	Mg/l	100	628	3135	804	410	429	680	934		657		
Electrical conductivity (EC)	Us/cm	1500	1882	1618	778	2370	2420	2060	1652		1419		
Ortho-phosphate	Mg/l	5	22	11.5	3.88	5.6	17.03	65.5	30.38		1.2		
PH-physical Chemical		6.0-8.0	7.0	5.30	6.14	7.48	7.32	7.5	7.6		6.93		
Total phosphorus (TP)	**Mg/l**	**10**	**26.5**	**19.5**	**7.85**	**7.78**	**19.00**	**68.7**	**45.8**		**86.1**		
Total suspended solids (TSS)	**Mg/l**	**100**	**145**	**358**	**151**	**120**	**211**	**422**	**224**		**473**		

KABALE AREA

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	mg/l	800	790	884	920		790	510	680			120	
Ammonia N	mg/l	10.00	77	4.25	12.8		55	70	94.5			58.8	
Bacteriological: Feacal coliforms	mg/l	10000	-	ND	240		500	ND	ND			5500	
Biochemical Oxygen demand (BOD)	mg/l	50	307.4	82	30.38		59	527	42.92			ND	
Chemical Oxygen demand (COD)	Mg/l	100	580	164	-		155	1898	199			251	
Electrical conductivity (EC)	Us/cm	1500	2260	2190	1766		2160	1312	2420			1692	
Ortho-phosphate	Mg/l	5	34	31.0	5.11		10	40	27.3			17.38	
PH-physical Chemical		6.0-8.0	8.0	7.7	7.35		7.51	7.4	8.1			ND	
Total phosphorus (TP)	**Mg/l**	**10**	**47**	**43.0**	**10**		**11**	**41**	**54.4**			**17.75**	
Total suspended solids (TSS)	**Mg/l**	**100**	**109**	**25**	**10**		**23**	**373**	**208**			**110**	

MBARARA AREA

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	**mg/l**	**800**	**328**	**620**	**1040**	**820**				**560**	**410**	**160**	**620**
Ammonia N	mg/l	10.00	1.05	10.7	17.3	47				54.0	46.5	70.0	32.5
Bacteriological: Feacal coliforms	mg/l	10000	-	140000	220	6000000				7,900		18000	-
Biochemical Oxygen demand (BOD)	mg/l	50	266.87	234	85.6	141.98				68		-	-
Chemical Oxygen demand (COD)	Mg/l	100	576	241	149	351				273	620	578	261
Electrical conductivity (EC)	Us/cm	1500	1015	1747	1598	2160				1511	1642	1907	-
Ortho-phosphate	Mg/l	5	10.5	5.9	5.17	19.6				28.98	10.27	16.38	13.63
PH-physical Chemical		6.0-8.0	7.16	7.93	8.0	7.94				7.8	-	-	-
Total phosphorus (TP)	**Mg/l**	**10**	**14.5**	**6.29**	**6.63**	**33.2**				**38.5**	**15.49**	**17.38**	**20.35**
Total suspended solids (TSS)	**Mg/l**	**100**	**46**	**130**	**103**	**141**				**38.5**	**346**	**285**	**300**

FORT PORTAL

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	mg/l	800	540	20	1160	944		180		748			
Ammonia N	mg/l	10.00	33	34.75	32	10		77.5		96.5			
Bacteriological: Feacal coliforms	mg/l	10000	ND	ND	-	20,000		ND		1000			
Biochemical Oxygen demand (BOD)	mg/l	50	10.41	53.94	106.1	76.9		164		-			
Chemical Oxygen demand (COD)	Mg/l	100	372	180	204	172		350		1259			
Electrical conductivity (EC)	Us/cm	1500	1541	1639	1517	2280		1423		2100			
Ortho-phosphate	Mg/l	5	7	14.75	0.16	4.16		35.8		61.0			
PH-physical Chemical		**6.0-8.0**	**7.7**	**7.41**	**7.5**	**7.45**		**7.6**		**7.6**			
Total phosphorus (TP)	**Mg/l**	**10**	**17**	**22.25**	**0.68**	**5.95**		**37.5**		**62.1**			
Total suspended solids (TSS)	**Mg/l**	**100**	**59**	**17**	**36**	**63**		**111**		**135**			

MASINDI AREA

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	mg/l	800	550	490		1020	360	160	460	420			
Ammonia N	mg/l	10.00	52	31.5		43.5	20.5	4.0	56.75	50.5			
Bacteriological: Feacal coliforms	mg/l	10000	1E4	2E4		400	1,400	ND	-	13000			
Biochemical Oxygen demand (BOD)	mg/l	50	295.4	56		140	83	62	191	-			
Chemical Oxygen demand (COD)	Mg/l	100	762	543		444	274	88	543	508			
Electrical conductivity (EC)	Us/cm	1500	1758	912		2280	1134	1316	1581	1481			
Ortho-phosphate	Mg/l	5	18.5	14.5		21.15	5455	58.0	53.7	42.6			
PH-physical Chemical		6.0-8.0	7.8	8		7.50	766	8.4	7.5	7.7			
Total phosphorus (TP)	**Mg/l**	**10**	**20.5**	**17.25**		**39.45**	**616**	**68.20**	**71.1**	**648.8**			
Total suspended solids (TSS)	**Mg/l**	**100**	**266**	**184**		**247**	**172**	**370**	**343**	**252**			

HOIMA AREA

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	**mg/l**	**800**	**490**	**650**	**670**	**1010**	**316**	**120**	**760**	**670**	**480**		**810**
Ammonia N	mg/l	10.00	27.75	63	31.4	24.5	49.5	40	68.5	88.5	99		59
Bacteriological: Feacal coliforms	mg/l	10000	1E2	-	60	-	10,000	ND	-	7,400	140000		108000
Biochemical Oxygen demand (BOD)	mg/l	50	206.66	501	27.26	193	88	28	34	-	37.2		93
Chemical Oxygen demand (COD)	Mg/l	100	566	710	-	538	ND	112	434	358	397		181
Electrical conductivity (EC)	Us/cm	1500	1294	1653	1382	2350	1866	901	1907	1864	1957		1996
Ortho-phosphate	Mg/l	5	17	30.0	4.9	19.6	20	19.3	43.3	40.0	31		25.3
PH-physical Chemical		**6.0-8.0**	**7.6**	**7.3**	**7.39**	**7,41**	**7.7**	**8.2**	**7.8**	**7.6**	**7.19**		**7.74**
Total phosphorus (TP)	**Mg/l**	**10**	**14.5**	**43.5**	**6.6**	**36.1**	**20.3**	**22.3**	**53.1**	**46.4**	**32.72**		**47.33**
Total suspended solids (TSS)	**Mg/l**	**100**	**208**	**222**	**51**	**258**	**68**	**28**	**202**	**300**	**220**		**265**

GULU AREA

Parameter	Units	National Standards	2011			2012			2013			2014	
			Mar	June	Dec	Mar	June	Dec	Mar	June	Dec	Mar	June
Alkalinity	**mg/l**	**800**	**-**	**340**	**640**	**220**	**650**	**110**	**170**	**248**	**ND**	**420**	**290**
Ammonia N	mg/l	10.00	-	5.25	27	9.5	43.75	15.5	23	8.5	11.0	ND	11.75
Bacteriological: Feacal coliforms	mg/l	10000	-	304	80	5200	120000	ND	ND	500000	1200	ND	-
Biochemical Oxygen demand (BOD)	mg/l	50	-	58	70.1	47	180.8	22	57	-	93	326	161
Chemical Oxygen demand (COD)	Mg/l	100	-	100	199	342	608	76	148	435	105	ND	ND
Electrical conductivity (EC)	Us/cm	1500	-	551	688	774	2030	532	785	923	339	1029	937
Ortho-phosphate	Mg/l	5	-	4.0	4.56	4.13	24.5	28.0	32.75	31.7	24.5	ND	25.7
PH-physical Chemical		6.0-8.0	-	4.26	7.4	9.06	7.15	7.1	7.28	7.6	7.57	7.73	7.93
Total phosphorus (TP)	**Mg/l**	**10**	**-**	**16.25**	**5.58**	**5.2**	**26.88**	**30**	**43.95**	**45.6**	**ND**	**28.8**	**ND**
Total suspended solids (TSS)	**Mg/l**	**100**	**-**	**179**	**100**	**122**	**46**	**40**	**170**	**273**	**ND**	**ND**	**ND**

APPENDIX VIII; Analysis of Upstream & Downstream Effects of NWSC discharge

	Parameter	December 2011		September 2012		June 2013		March 2014	
		Up stream	Down stream	Up stream	Down stream	Up stream	Down stream	Up stream	Down Stream
Kampala area	Biochemical Oxygen demand (BOD)					-	-	79	167
	Chemical Oxygen demand (COD)					141	198	264	478
	Electrical conductivity (EC)					532	802	688	766
	Total suspended solids (TSS)					71	92	266	580
Mbale area	Biochemical Oxygen demand (BOD)	31	130.2	56.4	4.8	-	-		
	Chemical Oxygen demand (COD)	54	540	84	8	27.6	67.0		
	Electrical conductivity (EC)	8390	8710	533	134	928	802		
	Total suspended solids (TSS)	5	6	65	105	41	16		
Masaka area	Biochemical Oxygen demand (BOD)	87	36.54	12	8.1	37.4	51.5		
	Chemical Oxygen demand (COD)	231	114	4	20	98	109		
	Electrical conductivity (EC)	85.5	73.1	63.1	333	1171	1394		
	Total suspended solids (TSS)	40	11	10	20	14	27		
Mbarara area	Biochemical Oxygen demand (BOD)	18.6	24						
	Chemical Oxygen demand (COD)	88	90						
	Electrical conductivity (EC)	1269	1358						
	Total suspended solids (TSS)	8	17						
	Chemical Oxygen demand (COD)	180	245			81	92		
	Electrical conductivity (EC)	369	369			488	493		
	Total suspended solids (TSS)	8	5			18	22		
	Chemical Oxygen demand (COD)	-	-			73	-		
	Electrical conductivity (EC)	198	-			149	-		
	Total suspended solids (TSS)	13	-			16	-		

APPENDIX IX; Pictures of Some of the Inspected ponds

Sections of the Anaerobic pond at Kakoba Ponds in Mbarara.

Sections of the Nyamitala ponds in Mbale

Sections of the Masaka plant were visually rusty and some parts were broken

Sections of the Hoima ponds filled with sludge.

Sections of the Jinja ponds filled with sludge with evidence of channelled flow of the sewage.

Part of the well maintained Entebbe ponds

Sections of the well maintained Kabale Ponds.

Source; OAG Picture taken during Inspection of the treatment facilities

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