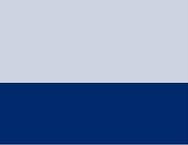


Juba City Sanitation Reform and Investment Plan 2015 -2030



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Acronyms

BOD	Biochemical Oxygen Demand
CEG	Central Equatoria Government
CES	Central Equatoria State
CPA	Comprehensive Peace Agreement
ePORT	Electronic Project Observation Reporting and Tracking
GIS	Geographical Information Systems
GPS	Global Positioning System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICT	Information Communication Technology
JCC	Juba City Council
JC	Juba County
JICA	Japan International Cooperation Agency
MDTF	Multi- Donor Trust Fund
MEDIWR	Ministry of Electricity, Dams, Irrigation and Water Resources
MLHPP	Ministry of Lands, Housing and Physical Planning
MoH	Ministry of Health
NBS	National Bureau of Statistics
RSS	Republic of South Sudan
SISP	Sudan Infrastructure Services Project
SSUWC	South Sudan Urban Water Corporation
SUWASA	Sustainable Water and Sanitation in Africa Program
TSS	Total Suspended Solids
UN	United Nations
USA	United States of America
USAID	United States Agency for International Development
UTM	Universal Transverse Mercator
VIP	Ventilated Improved Pit Latrines

Foreword

It is my pleasure to present the Juba City Sanitation Reform and Investment Plan which reflects our strategic approach to delivering and improving sanitation services for the inhabitants of Juba City. Responsibility for delivering services, including sanitation services is assigned to the municipal authorities and they must therefore be at the center of any strategic planning process. Even though the power to set budgets, determine policy, spending priorities and institutional arrangements often lies with the state or national government, it is usually steps taken locally that can make a real difference to the quality of services.

Those of us who are operating at the municipal level face major constraints, but existing laws and procedures often provide sufficient flexibility to enable committed individuals and corporates to figure out ways to overcome these constraints. This plan is therefore a reflection of the Juba City Council's willingness and determination to fulfill its obligations on sanitation as per the provisions of the Local Government Act.

The rapid growth of Juba over the past decade poses a significant sanitation challenge to Juba City authorities. Indeed the recent cholera outbreak in Juba City in 2014 emphasized the need to adopt an integrated strategic approach for dealing with sanitation issues sooner rather than later; hence this plan.

The plan presents challenges related to the containment, transportation and treatment and disposal of fecal waste in Juba, whilst also discussing the related institutional and financial challenges. The plan also describes interventions for the short, medium and long term (2015-2020; 2021-2025; 2026-2030) aimed at increasing sanitation access to 85 percent by 2030, effective management and regulation of private exhauster tankers, completion of the Roton lagoon together with related improvements in operation and maintenance and gradual introduction of a sewer system in the city.

This plan is a result of a thorough and wide consultative process facilitated and led by USAID's Sustainable Water and Sanitation in Africa (SUWASA) Program. The plan has benefitted substantially from the Juba City Sanitation Investment Plan Working Group which brought together all relevant government agencies, development partners, non-governmental organizations and the academia to deliberate the sanitation problem and possible solutions.

A key goal of the plan is to create an enabling institutional and regulatory framework to facilitate generation of funding for Juba City Council to accelerate sanitation services development in Juba City. I therefore call upon the Government, development partners, the private sector, non-governmental organizations, and residents of Juba to partner with us in implementing this plan.



H.W. Christopher W. Swaka,
Mayor of Juba
CES/ Republic of South Sudan

January, 2015.

Acknowledgements

Juba is our business and therefore sanitation in Juba, is our business. As Juba City Council, we have taken the first step in this business through the development of the Juba City Sanitation Reform and Investment Plan.

This plan has however been made possible by many actors. The Juba City Council is grateful to the United States Agency for International Development (USAID) for the technical support provided through its Sustainable Water and Sanitation in Africa (SUWASA) Program. USAID facilitated all studies related to developing this plan, organized consultative workshops and an official launch.

Appreciation also goes to the staff of the Ministry of Electricity, Dams, Irrigation and Water Resources, Ministry of Lands, Housing and Physical Planning, Ministry of Environment, Ministry of Health at both National and Central Equatoria State level, Ministry of Finance, the Local Government Board, Juba County, Juba City Council, South Sudan Urban Water Corporation, Juba University, GIZ, UNICEF, UNEP, PSI, OXFAM, who formed the Juba City Sanitation Reform and Investment Plan Working Group. This group provided technical input and reviewed all documentation related to the production of this Plan.

Special thanks go to Dr. Barbara Kazimbaya Senkwe of SUWASA and Mr. Albert Jada of Juba City Council for leading this process and Mr. Andrew Woodcock of Tetra Tech (USA) for providing technical support.

Executive Summary

The rapid growth of Juba over the past decade poses significant challenges for Juba city authorities in providing basic services including sanitation. Access to sanitation is very low and piped sewerage is almost nonexistent. The Roton Wastewater Treatment Lagoon is functioning poorly and will soon not have the capacity to handle the city's fecal waste. The impact of inadequate sanitation coverage combined with poor hygiene behaviors has led to a prevalence of waterborne diseases in Juba such as stomach ailments, diarrhea and cholera. There is also a lack of clarity and definition on the roles and responsibilities of the multiple government agencies involved in urban sanitation. Technical capacity and financial resources are also inadequate. There is an urgent need to reform and invest in institutions and infrastructure.

In response to this need and in support of South Sudan's desire to provide basic services to its people, the United States Agency for International Development (USAID) through its Sustainable Water and Sanitation in Africa (SUWASA) project provided support to the Juba City Council to develop the Juba City Sanitation Reform and Investment Plan. The plan was developed by the Juba Sanitation Investment Plan Working Group, a close collaboration of key government ministries and agencies, donors, and nongovernmental organizations that was established by Juba's mayor. The plan identifies priority sanitation reforms and investments to be undertaken from 2015 to 2030, with the aim of sustainably achieving at least 85 percent sanitation coverage in Juba by 2030.

The Current Sanitation Situation in Juba

Several studies SUWASA conducted from August 2013 to July 2014 provided insights into the state of urban sanitation. They serve as the basis for the recommendations in the Juba City Sanitation Reform and Investment Plan. The topics of study included:

Containment of fecal sludge in households and public toilets: According to a 2013 household sanitation survey SUWASA conducted, 55 percent of households have access to a toilet; 40.7 percent share a toilet; 2.7 percent practice open defecation; the remainder use public toilets. Of the households with private toilets, only 2 percent have access to a sewer connection; the rest use pit latrines or pour-flush toilets. Toilets are generally poorly constructed and only about 40 percent can be emptied using mechanized exhausters. Other toilets are abandoned and new pits dug. There has been an increase in the number of public toilets, most of them developed and managed by the private sector.

Transportation of fecal sludge: Juba has a very active and relatively profitable mechanized exhauster service sector that handles over 96 percent of fecal sludge. Over 150 exhauster tankers operate in Juba and over 97 percent of them are owned by private companies or individuals. Nine are owned by four public sector agencies. The average cost of emptying a household latrine is between US\$88 and US\$122, a high price when compared to the average of US\$60 in other African countries. The Juba City Council is responsible for registering the tankers, but regulation is limited to issuance of operational licenses and disposal permits. The fees from the licenses and disposal permits annually contribute about US\$1.3 million to the public sector. This revenue is not ring-fenced, however, and is not reinvested in the sector.

Treatment and disposal of fecal sludge: Sludge treatment is provided at the Roton Wastewater Lagoon located outside of the city boundaries. (Two smaller lagoons in Hai Amarat and Kololo, within the city limits, treat sewage from the small sewer networks that serve government offices and ministerial homes.) The Roton Wastewater Lagoon is managed by the Juba County administration. The capacity is 3,300 cubic meters a day with the possibility for expansion to 9,500 cubic meters a day. The facility is currently operating at 70 percent of installed capacity and is expected to reach full utilization by 2020. The lagoon is not properly operated and managed and produces foul smells and poor-quality effluent. Tanker emptying charges at the lagoon contribute US\$555,364 in revenue annually.

Institutional and financing arrangements: The lack of clarity on institutional roles and financial responsibilities is a significant drag on the sector. There are at least six government agencies at the national, state and city level with a role in urban sanitation. They include the Ministry of Lands Housing and Physical Planning (MLHPP), the Ministry of Electricity, Dams, Irrigation and Water Resources (MEDIWR), the Ministry of Health, the Ministry of Environment, Juba County and the Juba City Council. However, none has the necessary technical capacity or resources to effectively manage sanitation services. The sector relies on the private sector for investment in exhauster tankers and most public toilet construction. Households pay for their toilet construction. There is no dedicated public financing stream for maintenance and improvement of the sanitation sector. The only notable public investment has been the construction of the Roton Wastewater Lagoon and the rehabilitation of the two small lagoons in Kololo and Hai Amarat.

Elements of the Investment Plan

The plan is organized into three five-year planning periods covering 2015 to 2030. It balances institutional strengthening measures and reforms with expansion and improvement efforts in three ways: containment of fecal sludge for household and public toilets; collection and transportation of fecal sludge; and treatment and disposal of fecal sludge. The plan proposes actions designed to increase coverage as shown in the table below.

Sanitation Coverage Goals for the Investment Plan

Planning Period	Total Coverage Goal	Private Toilet Coverage Goal	Public Toilet Coverage Goal
2015-2020	55%	50%	5%
2021-2025	70%	63%	7%
2026-2030	85%	78%	7%

The first five-year planning period will focus on improving and expanding Juba’s existing operational scheme while developing the institutional capacity to regulate, plan, deliver, monitor and finance the sector. This period focuses on the critical needs of the sector; addressing critical health and environmental risks, immediate small-scale investment requirements and demand generation. It also includes a strong emphasis on institutional building and improvements in regulatory and enforcement mechanisms.

- Containment of Fecal Waste: The plan proposes construction of more household and public toilets to increase coverage from 40 percent to 85 percent by 2030 using a demand-driven approach. The plan proposes limited government subsidies for households that are unable to meet the full cost of constructing toilets. The plan also delegates the management of public toilets to the private sector to ensure sustainability, even when construction is financed by the public sector.

- **Transportation of Fecal Waste:** In the short and medium terms, exhauster tankers will remain the appropriate mode for transporting fecal waste to the Roton Wastewater Lagoon. Hence, the private sector will continue to have an important role in fecal sludge management. However, there will be oversight by a stronger regulatory regime focused on overseeing tanker routes, proper parking, penalties for pollution, and measures for worker safety. Transport of sewage through a sewer network will be incrementally implemented in the future as conditions permit.
- **Treatment of Fecal Waste:** The plan proposes that existing wastewater treatment facilities be used and it emphasizes the need to expand the Roton Wastewater Lagoon to full capacity. The plan also calls for continued use of simple technologies such as stabilization ponds. The plan's proposals are consistent with the experience of other African countries and make the best use of available resources. The plan proposes a stronger focus on operation and maintenance of the facilities in order to improve treatment effectiveness, sustainability and cost efficiency.

Institutional arrangements: The plan proposes improvements in institutional arrangements that allow the sector to attract and effectively utilize funding. Regulatory functions would be centralized in the Juba City Council, which will need technical and financial management capacity building. In the long term, the plan proposes that responsibility for the management of existing and new treatment facilities be transferred to a new entity to be created as part of a proposed urban water and sanitation services law.

Financing arrangements: The plan is estimated to require approximately US\$182.5 million for physical infrastructure and US\$25.24 million for software over the next 15 years. The plan proposes that users of sanitation services and facilities pay. It calls for providers to ensure value for money by setting reasonable tariffs and regulations. It is expected that income from the private sector (including households) will finance household and public toilets and exhauster tankers. In the long term, this income is expected to finance new connections to the sewer network. The public sector, according to the plan, will finance all public infrastructure including wastewater treatment facilities and a pilot program for a sewer system. The public sector could also provide targeted subsidies to encourage poor households to invest in toilets. The plan proposes that revenue generated from the sanitation sector, especially fees collected from the exhauster tankers be ring-fenced within general accounts and reinvested in the sector. Ring-fenced financing is expected to support sustainability of service delivery.

Juba is the newest capital city in the world and presents service delivery challenges that can be turned into opportunities to build a great city. Through a deliberate, planned and coordinated approach that draws in the government, households, private sector and development partners, Juba can address its sanitation problems and be an example to other cities in South Sudan and in Africa. The Juba City Sanitation Reform and Investment Plan is a first but important step in this direction.

I.0 Introduction and Background

The rapid growth of Juba, the capital city of South Sudan, over the past ten years has presented municipal authorities with a multitude of challenges, among them the critical matter of providing adequate sanitation facilities for an ever-growing population in a service area that increases in size. In 2009, it was estimated that urban sanitation coverage in South Sudan was at 19 percent, a very low figure compared to other African nations with poor sanitation (WSP 2010). The challenge is even greater in cities like Juba that are growing at rapid rates.

Juba's territory has expanded by over 230 percent from 2002 to 2012 as the population has more than tripled from 163,000 in 2005 to 500,000 in 2013. Access to sanitation remains low and estimates indicate that only about 55 percent of households have access to a toilet. Public infrastructure such as piped sewerage is almost non-existent. The existing wastewater lagoon is incomplete and will soon be inadequate to serve the population. At the same time, hygiene behaviors including proper toilet maintenance and hand washing with soap are very poor.

The impact of inadequate sanitation and hygiene practices is seen in the high prevalence of waterborne diseases, in particular diarrhea and cholera. According to a 2013 baseline survey by SUWASA, 64.4 percent of respondents indicated that a household member had visited a clinic in the previous six months for stomach ailments. The average number of clinic visits in the preceding six months was 5.74 times per member of the household. In May 2014, the Minister of Health declared a cholera outbreak, which had affected 5,697 people and killed 123 across South Sudan by August 2014 (UNOCHA Aug 2014).

On a positive note, the private sector – whose activities are regulated to some degree by Juba County, Juba municipality and local payam governments – has stepped in to provide sludge pumping and transportation services across the city. The private sector also contributes revenue that could be used to reinvest in the sanitation subsector.

The dynamic role of the private sector, the willingness of government to improve urban sanitation, and the seeds of financial viability – all indicate some potential to improve Juba's sanitation services. However, improvement will require investment, reform, the streamlining of sector roles and responsibilities, increased accountability, increased transparency and prioritization.

It is against this background that the United States Agency for International Development (USAID) through its Sustainable Water and Sanitation in Africa (SUWASA) project provided support to the Juba City Council as it developed the Juba City Sanitation Reform and Investment Plan. It is expected that the plan will assist the municipality as it further defines medium and long-term public and private investment priorities to improve sanitation services and ultimately, improve the health and economic prospects of Juba's citizens.

The plan defines the sanitation problem in Juba, identifies possible solutions, quantifies associated and prioritized investment needs, and provides a basis for capital budgeting for the Juba City Council, the state, the national government, the private sector and households. It also provides a framework for attracting investment from international aid and donor agencies.

The plan has been prepared with input from a working group of relevant government agencies and cooperating partners working in water and sanitation that was established by Juba's mayor.

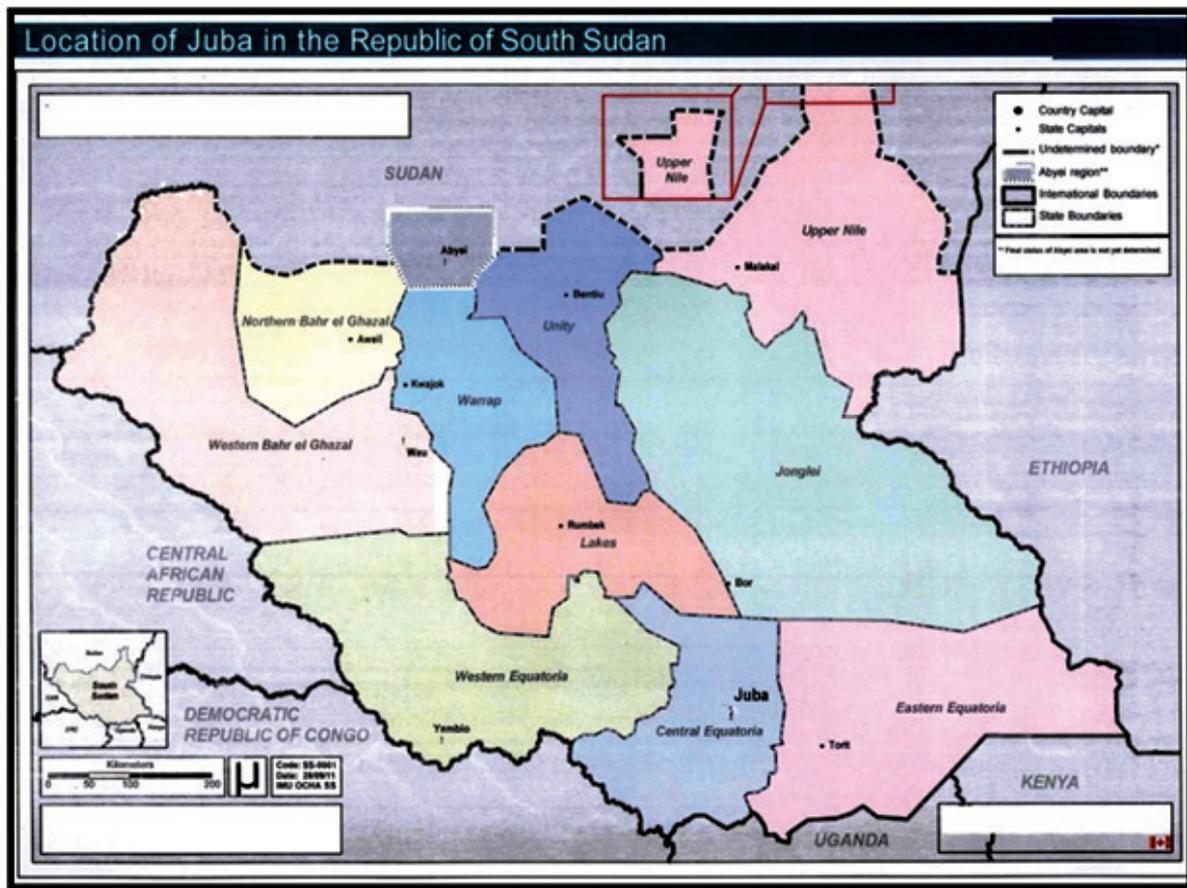
This document is organized as follows:

- Chapter 2 provides an overview of Juba.
- Chapter 3 outlines the sanitation situation in Juba, focusing on the three components of the fecal sludge management supply chain: containment of fecal sludge and hygiene practices; collection and transportation of fecal sludge; and treatment, disposal and reuse of fecal sludge.
- Chapter 4 examines the need for an adequate institutional, regulatory and financing framework.
- Chapter 5 presents the Juba City Sanitation Reform and Investment Plan, focusing on interventions in the three components.
- Chapter 6 discusses proposed financing arrangements to support the Plan.
- Chapter 7 presents proposed institutional arrangements.
- Chapter 8 highlights recommended priority actions.

2.0 The City of Juba

Juba Town was established in 1930 as the headquarters of Mongalla Province and in 2011, following rapid growth and continual service as a regional or State capital, Juba City, as it is now called, became capital of the newly independent country of South Sudan. Juba City is located between latitudes 4° and 5° North and longitudes 31.30° and 31.45° East. It is situated about 450 to 540 meters above sea level (Map 1).

Map 1: Location of Juba



2.1 Climate

In general, temperatures are high throughout the year with distinct characteristics of a dry and rainy season. Monthly average temperatures range between 19.4°C and 23.7°C with a monthly average maximum of 31.5°C and 37.9°C. The rainy season is between May and October with average annual precipitation of 1000mm although occasionally 1200mm can be reached.

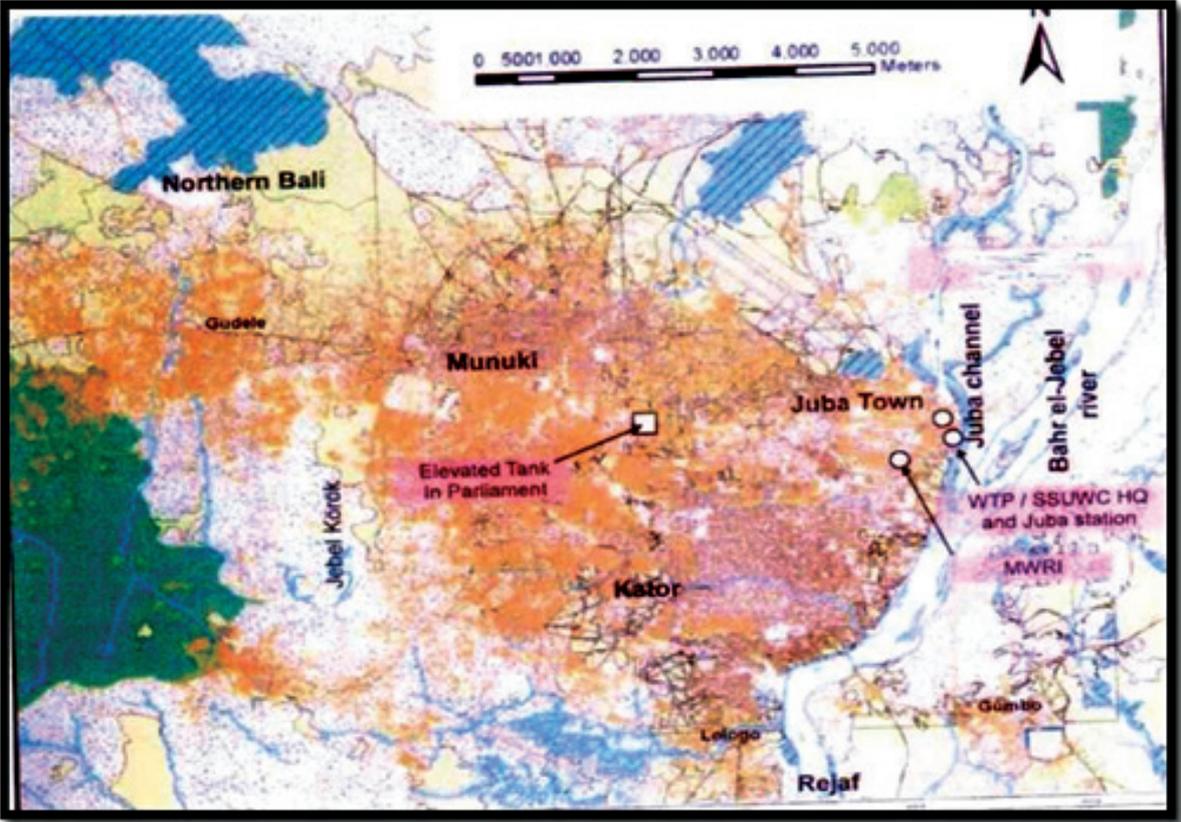
2.2 Topography

The City of Juba is located in the large Bahr al Jebel alluvial plain which inclines from South –Southwest to the North-Northeast direction. The White Nile River, with a width of between 250m to 600m, delineates the town boundary in the East. The town has a gentle slope with outcrops of hard and firm crystalline rocks around, the most outstanding being the Jebel Krok with an altitude of 744m above

sea level, 3km wide and 1 km long. Jebel Krok forms the western boundary of the town. In the rainy season, flood wastewaters affect an area covering almost 50 percent of the alluvial plain prompting the emergence of the temporal and seasonal rivers that flow into the White Nile River.

Administratively, Juba City consists of three blocks (payams), namely Juba Town, Munuki and Kator. Northern Bari and Rejaf are the other two blocks that are part of Juba County (Map 2).

Map 2: Juba City Topography and Administrative Boundaries



2.3 Soils and Geology

The area is characterized by luvisols soil which is generally well to imperfectly drained. They have a tendency to form strong sealing on the surface which may cause high run off rates by impeding infiltration. The geology of the area is largely defined as basement system of rocks. Underground water is generally found at five to six meters below the ground surface.

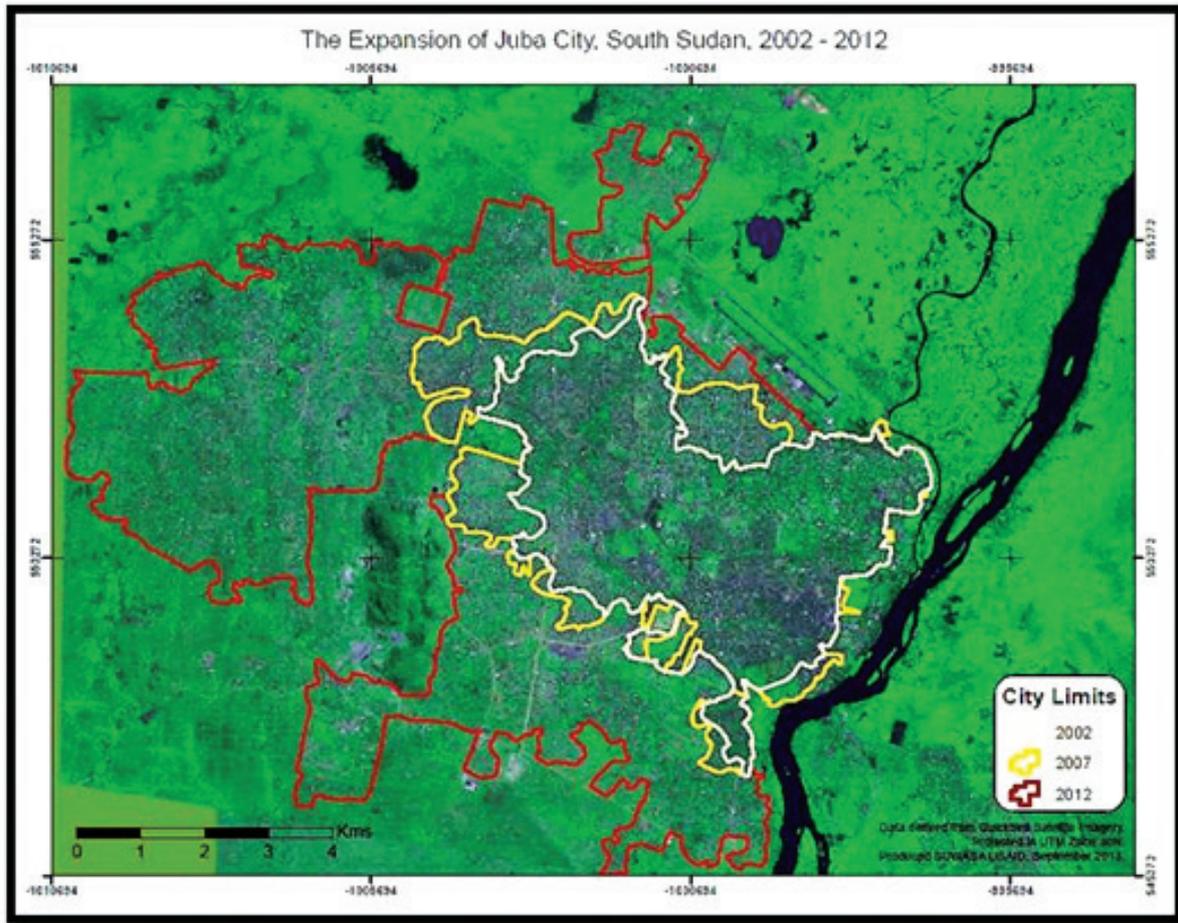
2.4 Vegetation

The vegetation in the area is predominately shrubby grassland. Dominant grasses found in the area are themedatriandra, pennisetumstraminuem and cenchrusciliaris.

2.5 Geographic Growth of the City

Juba grew rapidly between 2002 and 2012. In 2002, the city had an area of 21.55 km², in 2007 it was 27.44 km² and by 2012, the city covered 71.22 km². This represents 230 percent growth over a ten year timeframe (Map 3). This growth is characterized by marked changes in settlement density and significant formalization of settlements from 2007 onwards. Expansion to the west and south is the most noticeable growth trend with the eastern limit constricted by the presence of the White Nile.

Map 3: Geographic Expansion of Juba City



2.6 Layout of Juba City

The population is distributed across five broad settlement types, namely;

- 1) Established Formal Areas that had been formally laid out with a clear grid road network in 2007;
- 2) Transitional Formal Areas which had started off as informal settlements but were formalized in a Town Planning Exercise in 2008/9;
- 3) New Formal Areas which were green fields in 2007 but were formally settled in 2012;
- 4) Recent Informal Areas established in green fields since 2007; and
- 5) Enclosed Open or Official Spaces designated for official use including the UN compounds, government ministries etc.

Map 4 shows the geographic distribution of these areas.

Map 4: Juba Settlement Typologies

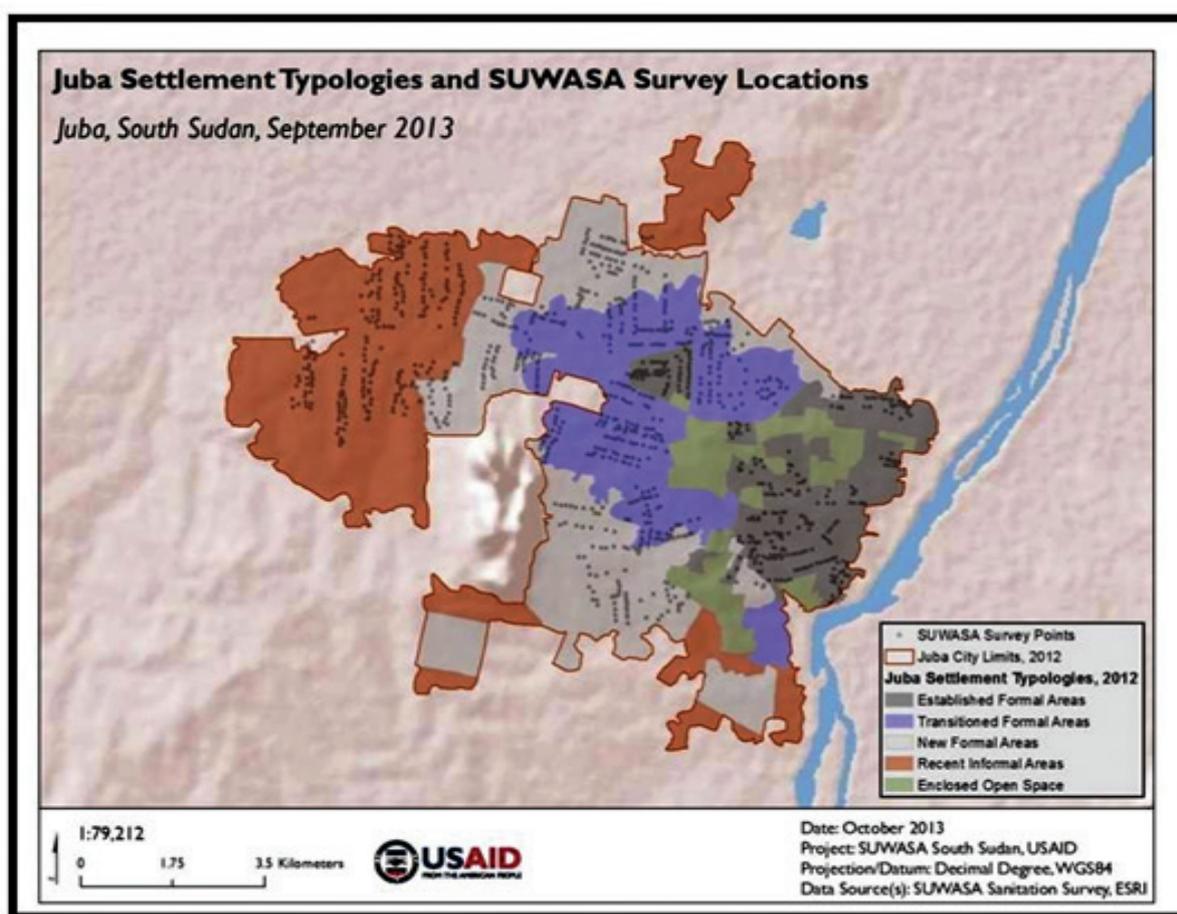


Table 1 shows the settlement typologies by geographic area with the indication that the Recent Informal Areas occupy the largest area (i.e., 2,410 hectares). These typologies are a useful framework for the purposes of the Investment Plan given that each typology has specific attributes, characteristics and needs.

Table 1: Juba Typology by Area

Typology Class	Area (Hectares)	Typical Neighborhoods
Type 1 – Established Formal Areas	1,013	Juba, Hai Malakal, Hai Jalaba, Buluk, Atlabara A, Atlabara B, Atlabara C, Hai Neem, Hai Mayo, Hai Negli, Hai Cinema, Kator, Malakia, Konyo Konyo, Hai Thoura, Malakia, Hai Kuwait, Munuki Block B, Munuki Suk Libya, Hai Amarat.
Type 2 – Transitioned Formal Areas	1,443	Munuki block A, Munuki Block B, Munuki Block C, Hai Tarawa, Hai Seminary, Rock City, Hai Mouna, Munuki Dar es salam, Gudele one, Cutoms, Nyokuron, Tongping, Suk Sita.
Type 3 – New Formal Areas	1,978	Mia Saba, Gudele one, Suk Jebel, Rock City, Kator, Kor William.
Type 4 – Recent Informal Areas	2,410	Lologo, Gurei, Suk Zande, New site, Jebel Insua, Kopuri.
Type 5 – Enclosed open Space	527	Jebel Kujur (Mountain), Big Ben Secondary school, UN Compounds, SPLA Military Barracks, Playing ground.
Total	7,371	

2.7 Land Tenure

Land in Juba is administered by two main authorities namely, The Ministry of Infrastructure and Rural Water (CES) and the traditional chiefs. All land in the formal or planned areas (also referred to as First, Second and Third Class) is zoned and allocated by the ministry which issues 99 year leaseholds. The Juba City Council administers all these land and therefore, has the responsibility and the right to enforce required sanitation and public health standards. On the other hand, land in Informal Areas (Fourth Class) is held by traditional chiefs on behalf of the community. The council therefore has no direct control over this land and enforcement of sanitation standards would be difficult. It should be noted that if necessary, the council can acquire land from the traditional leaders through the Ministry of Infrastructure.

2.8 Population And Household Characteristics

The most recent official population data for Juba is from the 2008 Census published by the Southern Sudan Centre for Census, Statistics and Evaluation (SSCCSE). The census lists the 2008 population of Juba County as 368,436, up from an estimated 163,000 in 2005. In 2013, the population of Juba City was estimated to be 500,000 (SUWASA 2013). SUWASA's 2013 household survey revealed that the average household size in Juba was 9.36 people, which is slightly higher than the reported national urban household size of 7.1 people (NBS 2012:13). There were also more adults than children in the households. The large household size and adult population is partly as a result of displacement due to the conflicts in the country and also due to a cultural practice in which those with financial capacity or property in the urban area, house relatives from the extended family. For instance, out of a total of 1,032 respondents, 4 percent had more than 20 people in a household. The highest household size was 42. It is also worth noting that children under the age of five years are present in over 72 percent of Juba households. The presence of children under-five is a key factor in any sanitation and hygiene promotion intervention as this is the group that benefits significantly from improved sanitation and hygiene. Conversely, this segment of the population also suffers the most from the lack of these services through diarrheal diseases, and related under-five infant mortality.

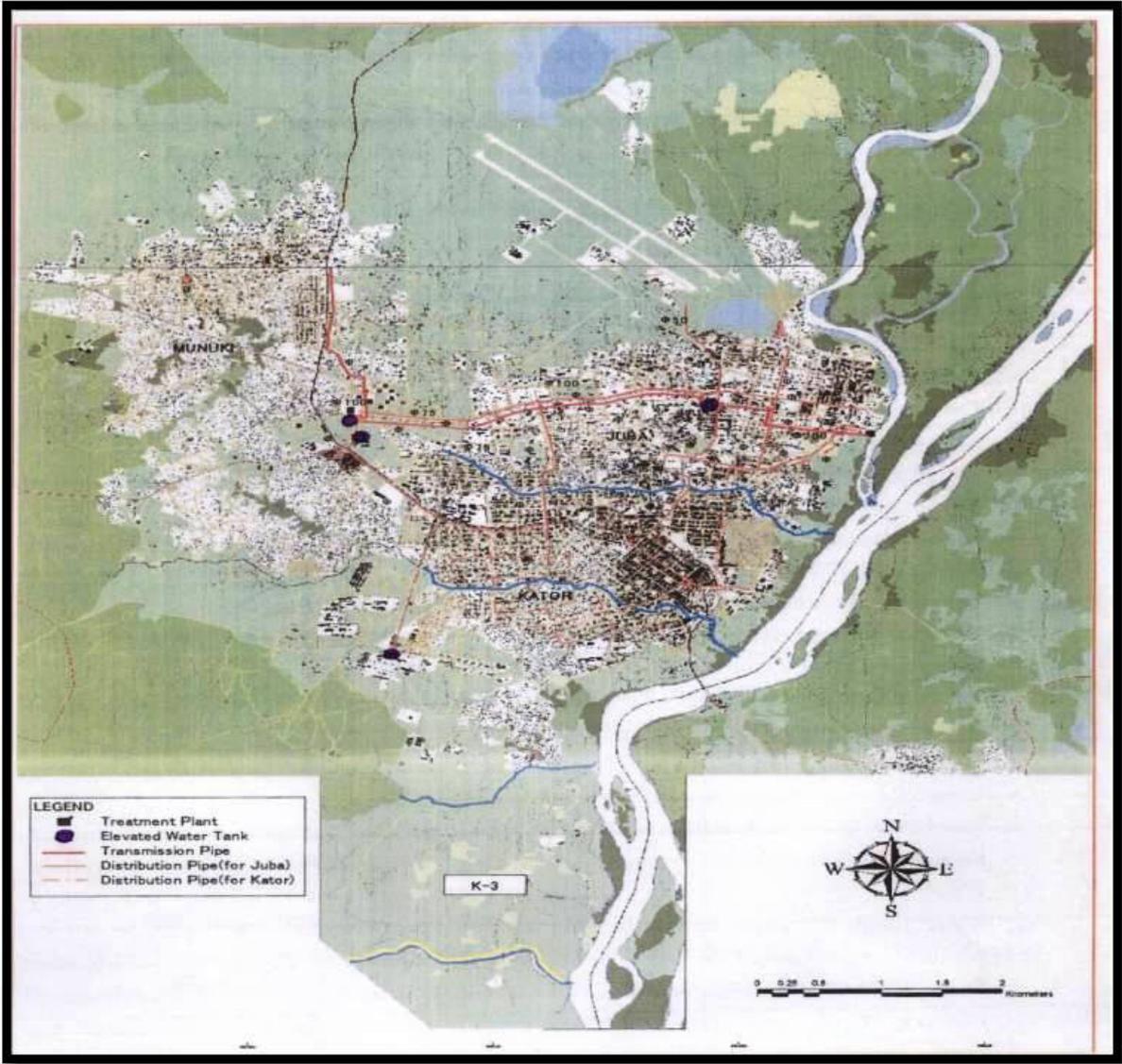
2.9 Sources Of Drinking Water In Juba

Water in Juba City is supposed to be provided by the South Sudan Urban Water Corporation (SSUWC). However, SUWASA's 2013 Juba Household Survey found that majority of households (81 percent) obtained their drinking water from water tanker vendors who obtain treated water from water tanker filling stations managed by South Sudan Urban Water Corporation, although some supply untreated water obtained directly from River Nile. Piped water to individual yards or house connections was reported to be extremely low (3 percent) as was access through public stand points (1.1 percent) provided by both SSUWC and increasingly by non-governmental organizations. Eight percent of the households obtained their water from private tubewells. A small portion of the population (i.e. 2.3 percent and 0.5 percent) obtain their water from hand dug wells and rivers and streams respectively. The remaining households obtained their water from water vendor carriers (2 percent), others (1.1 percent) and bottled water (0.4 percent).

Limited access to piped water supply is due to the inadequate capacity of the SSUWC. From 1937, water supply in Juba was provided by the Public Electricity and Water Corporation (PEWC) owned by the Government of Sudan. The PEWC was unbundled in 1994 and water became the responsibility of the National Water Corporation (NWC). Following the Water Policy of 2007, the South Sudan Urban Water Corporation (SSUWC) was established by Decree and in 2011 a Provisional Order was issued creating the SSUWC and its Board of Directors (BoD). SSUWC manages and operates very limited infrastructure, comprised of a small water treatment plant with a capacity of 7200m³/day. With

current water losses estimated at over 50 percent, SSUWC estimates that they are probably distributing about 3000m³/day to 125,000 or 25 percent of the population in Juba. Treatment comprises of alum dosing, flocculation, coagulation, sand filtration and chlorination. For storage, the utility has three storage reservoirs (one at the Juba Teaching Hospital, one to the North and one in Kator) and approximately 71 km of water supply network (see Map 5 below). The lack of an adequate piped water network is a key issue to consider in designing sanitation interventions in the city. It should be noted that the water subsector also has extensive investment requirements and will be an additional, and compelling option for any available financing (public or donor). The Government and stakeholders must stay committed to meeting the sanitation needs of the city in order to avert future health and environmental emergencies.

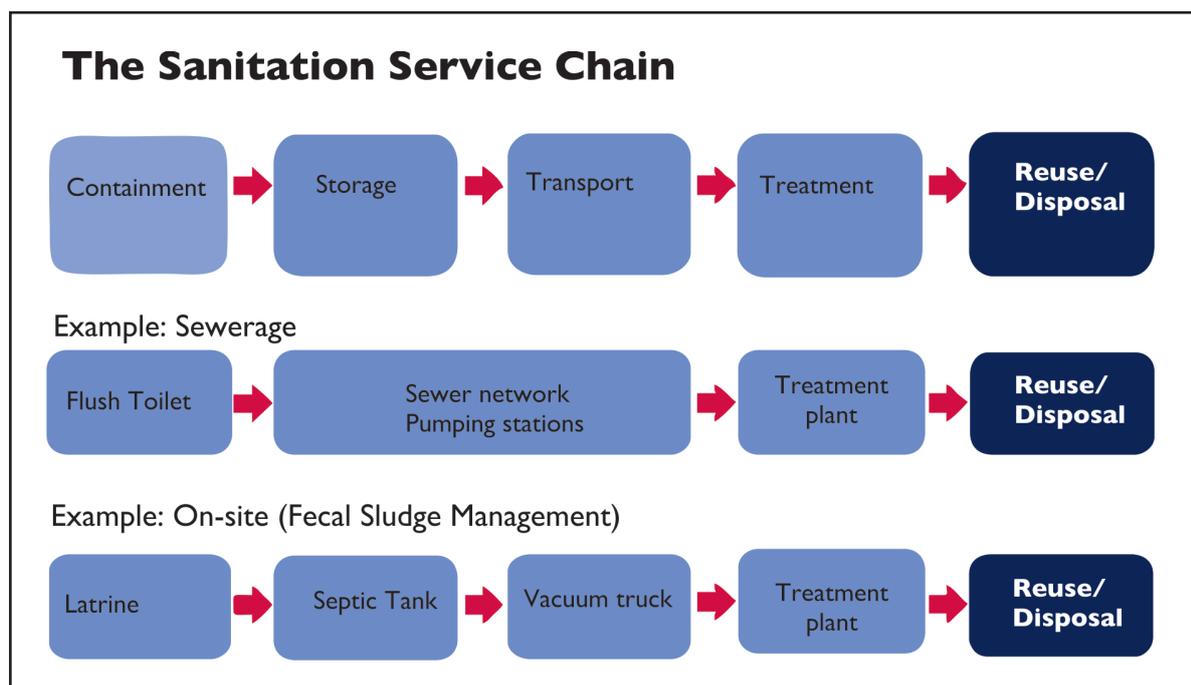
Map 5: Layout of Existing Water Supply Facilities in Juba



3.0 Sanitation in Juba

The problems in Juba City are accentuated by the many competing demands facing the new Government of South Sudan (GoSS) that has the task of delivering basic services in a fragile security environment. This chapter details the sanitation problem in Juba using the sanitation supply chain as an organizing frame (See Figure 1 below).

Figure 1: The Sanitation Service Chain



The sanitation problem is discussed under three components of the supply chain namely containment, collection and transportation, and treatment and disposal/reuse of fecal waste.

3.1 Containment Of Fecal Sludge

3.1.1 Containment of Fecal Matter at Household Level

At the household level, containment of fecal sludge in Juba is primarily through onsite technologies, particularly pit latrines. The SUWASA 2013 Household Survey showed that 81.4 percent had a working toilet ; 89 percent of these reported using pit latrines, while 9.4 percent used either a flushing or pour-flush toilet. Further analysis and verification of the results however showed actual access to improved sanitation was much lower; 55 percent of respondents reported having access to an individual household toilet whilst 40.7 percent shared a toilet¹. This means that access to improved sanitation in Juba currently

¹ As used in the plan, 'toilet' refers to any facility (at individual household level) that ensures that faecal matter is safely separated from humans. This should include all toilet types from properly constructed pit latrines, VIPs and all the way up to highest level on the sanitation ladder. In the case of Juba however, considering the fact that the use of water for anal cleansing is very high and can be said to be the preferred practice regardless of what toilet type households have, the pour flush type toilet is proposed as the preferred option for the Plan. This toilet type design would be at a slightly higher level than the VIP, but lends itself to emptying by mechanized tanker; whilst allowing the population to continue with their preferred mode of cleansing. This proposal does not however preclude the use of VIPs, especially that the difference in cost between the two, would probably not be very significant. The driving issue is ensuring that the technology used is the most hygienic and cost effective from a toilet emptying point of view.

stands at 55 percent (i.e. all those households who have access to a toilet which is not shared with neighbors). In essence, at least 224,500 people or over 23,000 households currently do not have access to improved sanitation² (Table 2).

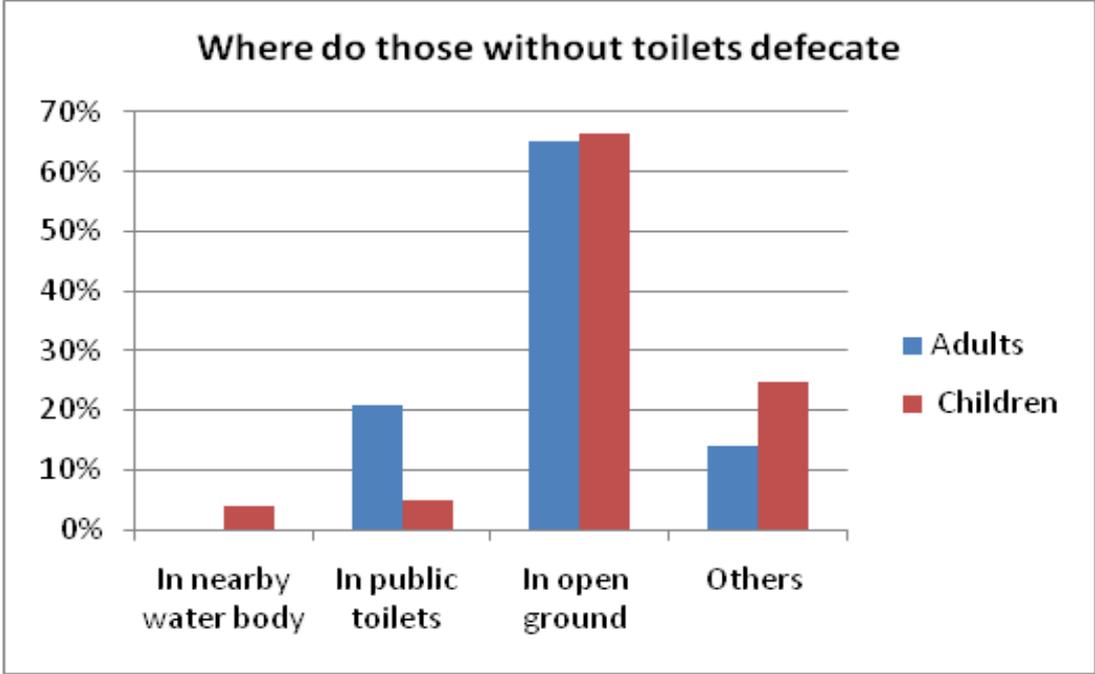
Table 2: Population in Juba with Access to Improved Sanitation

Category	Percentage	Population
Households with individual toilets	55	25000
Households sharing private toilets	40.7	203,500
Households without toilets	4.3	21 500
Total	100	500,000

Source: SUWASA Household Sanitation Survey, 2013

Of the 4.7 percent who indicated that they did not have a toilet, the majority of both adults and children used the open ground (65 percent), 21 percent used public toilets and 14 percent used other means (Figure 2).

Figure 2: Where do those without Toilets Defecate?



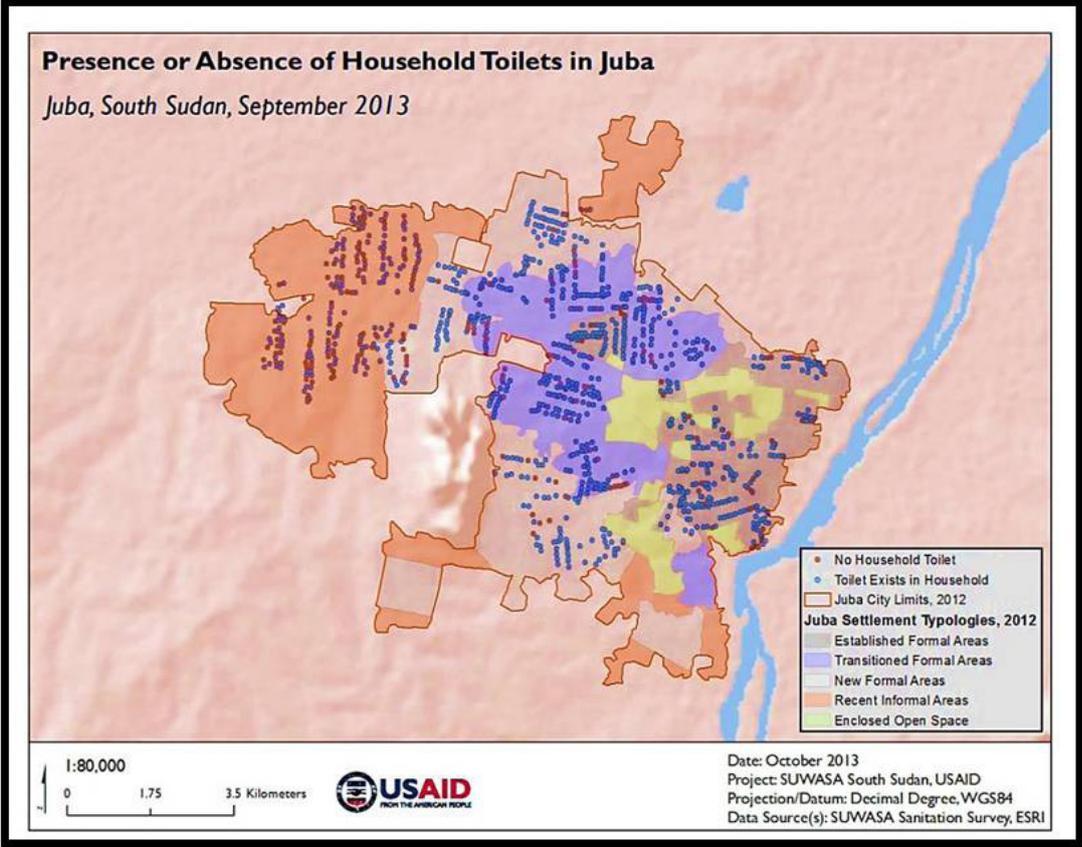
It is therefore noteworthy that open defecation is still an issue in Juba, and needs to be targeted for action.

Even though public toilets are used in Juba, they tend to serve transient populations using public facilities like markets and bus stations. They are therefore difficult and inappropriate to be considered as part of the 'Improved Access'.

As would be expected, the majority of people without adequate access to a toilet facility are in the informal settlements (Map 6).

² Access to adequate /improved sanitation facilities refers to the percentage of the population using improved sanitation facilities. The improved sanitation facilities include flush/pour flush (to piped sewer system, septic tank, pit latrine), ventilated improved pit (VIP) latrine, pit latrine with slab, and composting toilet. Some governments include traditional pit latrines although there is presently no such definition by the Government of South Sudan.

Map 6: Geographic Spread of Toilets in Juba



Not only is access to improved sanitation inadequate, but existing toilets are often not properly constructed. For instance, only 40 percent of households in the SUWASA survey have toilets that are either on a septic tank or have an underground structure that is lined with concrete or other material making them easily emptied by a vacuum tanker. Most pit latrines (60 percent) are not lined and therefore present challenges for mechanical emptying because of the high potential to collapse during pumping (Table 3).

Table 3: Septage Management

Description	Frequency	Percent
Piped sewerage	4	0.5%
Septic tank	22	2.7%
Concrete or other lining	304	37.3%
Unlined Pit	477	58.5%
Don't know	12	1.5%
Total	816	100

Secondly, focus group discussions with builders suggest that many people use the term 'septic tank' to refer to any hole that serves as a receptacle for human excreta. Furthermore, most properties, even those that do have septic tanks, do not have soak-aways. This raises the frequency of emptying, because of the lack of provision for infiltration of the liquid matter.

Almost a tenth, 9.1 percent, of pour flush toilets reported direct discharge into unlined pits. This means that the waste from these toilets cannot be emptied by a vacuum tanker and would have to be emptied manually or left to settle whilst using an alternative pit.

All these factors suggest that there is a need to focus on helping and encouraging households to build toilets that are properly designed and meet construction standards that not only protect the environment, but also allow for cost effective pit emptying.

As Table 3 shows, piped sewerage is almost non-existent in Juba serving only 0.5 percent of the population, including the ministries, ministers' homes and government offices, which are connected to two small lagoons at Koloko and Hai Amarat respectively.

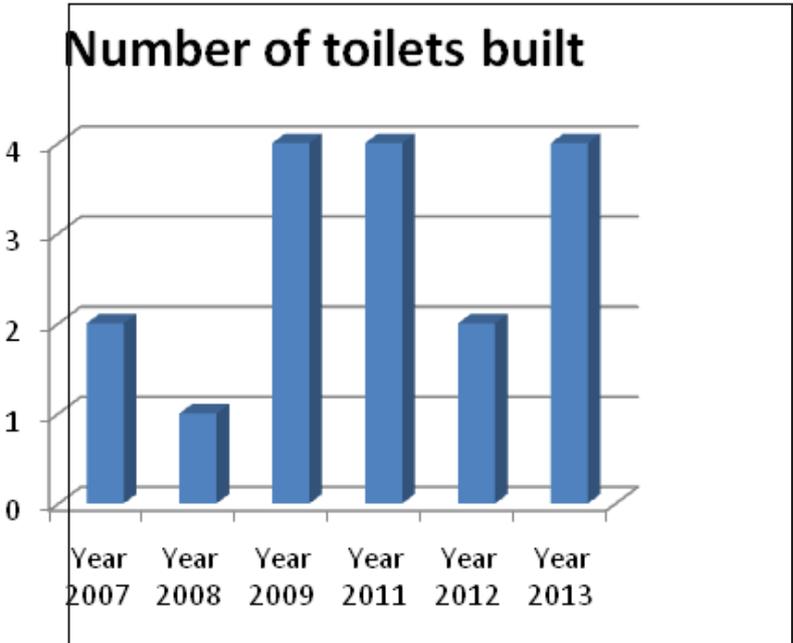
3.1.2 Hygiene Behaviors

Hygiene behaviors are relatively poor amongst the population. Based on the SUWASA Household Sanitation Survey (2013) while most people (99.8 percent) indicated that washing their hands was important, 46.4 percent reported that they had no hand washing facility. Furthermore, only 39.9percent indicated that they wash their hands after defecating, 32.2 percent before eating, 19.3 percent before preparing food and only 8 percent after handling a child's feces. These results are particularly worrisome given that the majority of respondents were female, and therefore primary handlers of water, food and children under age five in the household. There is a great need for hygiene behavior change within the city.

3.2 Containment of Fecal Sludge at Public Toilets

Juba has a significant number of public toilets although it is not clear what the exact number is. A survey of 21 public toilets³ undertaken by the SUWASA project in December 2013 found that there has been a steady increase in the construction of public toilets by the private sector between 2007 and 2013 (Figure 3).

Figure 3: Number of Public Toilets Built in Juba between 2007 and 2013



³ Public toilets refer to toilets that are open to anybody either in public places or in residential areas and are used on a pay per use basis. They are distinguished from communal toilets which toilets shared by a group of households in a community who generally do not pay for usage.

Although only about six public toilets were constructed by the public sector with funding from the World Bank's Multi Donor Trust Fund (MDTF) and USAID, the survey found another 14 public toilets that were built by the private sector. The largest toilets are those financed by donors and government. Most public toilets are operated and maintained by the private sector on a pay per use basis. Majority of the public toilets are located at markets, although some of the largest ones are at bus stops. On average the toilets are open for 13 hours each day.

The majority of the toilets are pour-flush types, although there are also Ventilated Improved Pit Latrines (VIP), flushing toilets and pit latrines. The major difference between the pour flush and the pit latrine type toilet is that the former is designed with a water seal (U-trap or siphon) used over one or two offset pits and water has to be poured in the toilet pan after each use. The latter only has a plain hole or seat and does not require use of water (See Annex 1). Almost all public toilets in Juba use squat pans to allow for anal cleansing with water. On average, the public toilet blocks had a total of 10 toilet units with an average 7 toilet units for men and 5 for women, while the average number of shower rooms was 7. Several case studies in developing countries indicate a usage range of 5 -30 households per public toilet. For this Plan, a service level of one toilet per 8 households has been adopted since it is on the lower end. Based on an average household occupancy rate of 9.36 persons per household the per capita level of service is 75 persons per toilet. This means that the 21 public toilets in Juba are serving about 8625 persons daily.

Almost all the toilets have a water storage tank as they all obtain water from private tankers. The average size of the storage tanks is 3,488 liters (Table 4).

Table 4: Key Parameters of Public Toilets Surveyed in Juba

	Shower rooms (#)	Water storage (Liters)	Filling up (Days)	Toilet Units (#)	Toilet units-men (#)	Toilet units-women (#)	How much to empty (SSP)	Daily Revenue from User Fees(SSP)
Total	142			218	89	65		
Average	7	3,488	13	10	7	5	786	353
Max	18	25,000	38	30	16	14	3,600	1,375
Min	0	400	7	1	1	1	190	70

Source: SUWASA Public Toilet Survey 2014

3.2.1 Management of the Public Toilets

While public toilets are serving about 8,625 people per day, they do not however provide adequate security, privacy, and hygiene for users. For example, out of the total 21 toilets surveyed, only 1 was built with two separate blocks (one for men and one for women); eight of the toilets had no separation between men and women (any one could use any toilet) and only half (10) had a wall separating the women from the men. Separation in the remaining 2 was by way of allocation of units in the block to either men or women. None of the 21 blocks provided sanitary bins for women. Similarly, only eight toilets had hand washing facilities inside the toilet while the majority had the facility (container or basin) outside the toilet. Signage is generally non-existent, while lighting and security are also a concern. In addition, more could be done to improve cleanliness as only half of the toilets (10) were observed to be clean, 8 in fair state and 3 in a poor state of cleanliness. All these elements mean that the toilets are not particularly suited to female users and this needs to be addressed. Use of protective clothing by attendants is almost non-existent with only 5 of the 21 toilets surveyed showing physical evidence of their utilization. On a positive note, soap was observed to be available in all but one toilet.

3.2.2 Fecal Sludge Management at Public Toilets

The public toilets are a key contributor to fecal sludge generation and transportation in the city. On average, the toilets take 13 days to fill up and are all emptied by private exhauster tankers. The average cost of emptying is SSP786 (US\$253) or about US\$506 per month, assuming they are emptied every 13 days.

3.2.3 Profitability of Public Toilets

On average, the toilets charge SSP1 for use of the toilet and SSP2 for showering per use. Respondents reported that on average they collect approximately SSP353 (US\$113) daily from customers. These figures suggest that on a monthly basis, public toilets can generate revenue of about SSP8,000 – 9,000 (US\$2580- 2703). Operational costs are about SSP6,800(US\$2193) for water, power, labor and general maintenance (Table 5).

Table 5: Typical Monthly Cost of Operating a Public Toilet in Juba

Calculation of average cost of operation per Month		
Parameter	Cost (SSP)	Cost (USD)
Water	2310	745
Electricity ¹	370	119
Emptying toilet twice a month	1572	507
Labor for Cashier/ cleaners	863	278
Sub-total operating cost	5115	1650
Maintenance costs 10%	511	165
Sub-total	5626	1815
5% profit	281	90.75
Total	5908	1906
Add 15% Administrative costs ²	886	286
Total average cost per month	6794	2192
Monthly Revenue	8472	2732
Operating Profit	1678	541

This means that a typical sized public toilet facility (consisting of 7 showers and 10 toilets) can generate a monthly operating profit of about SSP 1,678 (USD 541). Public toilets are clearly a key and potentially financially viable part of the sanitation solution in Juba. However, it is important that certain design and management aspects, including cleanliness can be improved upon to make them even more attractive to those that have no individual toilets.

3.3 Collection and Transportation of Fecal Sludge

Juba has a very active private mechanized exhauster service industry. Mechanical exhausting is widely sought by those with septic tanks and lined pit latrines. According to SUWASA's 2013 Household Survey, 20 percent of households reported that they had exhausted their toilets in the previous 12 months. Of these, the majority (96 percent) had used a mechanical exhauster, while only 4 percent exhausted manually.

An institutional survey of 13 private exhauster businesses and a count of trucks in the city revealed that there are at least 150 exhauster trucks operating in Juba, of which only nine are owned by public sector agencies. Exhauster trucks in Juba tend to be rather large in capacity, with the average truck size being 18,000 liters, the smallest about 3,600 liters, and the largest 55,000 liters. Using an average pit latrine size of 2,600 liters and a septic tank size of 5,000 liters on average, a typical truck in Juba can empty either 6.9 pit latrines or 3.6 septic tanks per trip. The preference for large capacity trucks in Juba is similar to other African cities where the average size of trucks according to Chowdry and Kone (2012) is above 10m³. Most trucks in Juba are purchased secondhand from countries outside South Sudan, with Dubai, Germany and Kenya as the dominant sources. The trucks are generally financed with capital from other businesses and or personal savings. Very few investors borrow from commercial banks for this activity. The fact that the trucks are mainly secondhand means that they have a shorter life span, higher maintenance costs and need greater regulation to ensure that they comply with environmental standards.

Compared to other African cities, Juba has a very high number of trucks per household. Assuming the 150 trucks estimated to be operating in the city, a population of 500,000, and a mean household size of 9.36 persons, the ratio of households to trucks in Juba is 358:1. This makes the ratio of households to trucks in Juba one of the highest in Africa. According to previous studies of the private mechanical tankers in Africa, (Chowdry and Kone *ibid*) Dakar has the next highest prevalence of tankers with 1,118 households per truck, a figure almost quadruple that of Juba. Currently, there is open competition in the city and exhausters are free to work anywhere as long as they have obtained and paid for a sanitary license.

In general, the trucks operate on a call basis rather than roaming the city. The fact that over 97 percent of these trucks are privately owned indicates both a thriving private market and a clear opportunity for the government to leave this market to the private sector while providing appropriate regulation and oversight of the tankers and encouraging the construction of latrines that can be mechanically emptied. This scenario is good for the consumers as it promotes competition. However, further analyses may be required to assess whether there is an oversupply of tankers in the city because such a scenario may have implications for survival of some emptiers, particularly the smaller ones.

3.3.1 Categorization of Exhauster Businesses

Exhauster businesses can be categorized into three types:

- Private exhausters run as part of another business;
- Private exhausters run purely as exhauster businesses for profit;
- Public exhausters run by government departments and the Block/Payam Councils.

Category A is further divided into two, namely hotels and other businesses because of the large number of tankers that are owned and operated by hotels (Table 6).

Table 6: Exhauster Business by Category

Truck Ownership	Number of Trucks	Percentage	Category of Truck Business
Hotels	33	22	A
Other businesses	24	16	A
Private	90	60	B
Payams	3	2	C
Total	150	100	

Source: SUWASA Survey of Exhauster Businesses in Juba, 2013/14

Category A: Exhauster Businesses Being Run as Part of Other Businesses

Exhauster businesses that are operated as part of other businesses often started as a means to empty the septic tanks associated with the other business. Most of these businesses bear the same name as that of the original business and operate under the same general license. From the 150 exhausters, 22 percent were directly associated with hotels while 16 percent were linked to other businesses mainly office and shopping complexes.

Private and Non Profit Exhausters: Among this group, some tankers are used only for collecting sludge from their hotel/business and are not in the exhauster industry as a business. These exhausters can therefore be classified as 'private and non-profit'.

Private and for Profit Exhausters: Some other trucks in category A, serve both their businesses/hotels and also operate as exhauster businesses serving other clients. Their external clients include commercial and domestic clients and government ministries.

Category B: Private for Profit Exhausters

Private for profit exhausters are the majority of the exhauster businesses (60 percent of the 150) which have been set up purely to provide a service for profit. Most operate throughout Juba County, while some only operate within the three city Payams of Juba, Kator and Munuki. The businesses collect sludge from all types of properties including government ministries, schools, hospitals, and commercial and domestic clients.

Category C: Public Exhausters

A number of public institutions including the University of Juba, Juba Prison and the Juba Teaching Hospital have their own exhauster trucks which only serve these institutions and are therefore non-profit making. However, the functionality of these trucks is inadequate as evidenced during the cholera outbreak of May 2014 when external tankers had to be brought in to empty the septic tanks in these premises. Similarly, none of the public institution tankers reported to the lagoon during one week of observing the tankers at the lagoon in July 2014, suggesting that they were probably non-functional.

Within Juba City Council, the three blocks (Payams) of Juba, Munuki and Kator each have two 7,500m³ capacity sewage trucks funded under the MDTF. These trucks are operated for profit by the Payams. The functionality of the public trucks is much lower than that of the private tankers. For instance, at the time of both surveys in 2013 and 2014, each Payam had only one truck working.

3.3.2 Profitability of Exhauster Truck Business

Based on financial figures reported by the truck owners and drivers, the exhauster business in Juba is quite profitable. On average, operating cost per truck per trip is calculated to be at about US\$100.31 as shown in Table 7. On average, trucks make 2.3 trips per day, which means that the daily cost of running one truck is US\$231 or US\$55,371 annually. The average purchase price of a truck is US\$60,240 (without a cost of capital as most are privately financed).

Table 7: Typical per Trip Cost of Operating one Exhauster Truck

Item	Parameter	Unit	Quantity
Fuel	Distance to and from Roton Lagoon	Km	20.00
	Consumption of fuel per trip	Liters	6.67
	Operating truck per trip	Liters	10.00
	Total fuel per trip	Liters	16.67
	Total fuel cost	US\$	33.33
Emptying Fee	Cost of Emptying at lagoon per trip	US\$	23.33
Labor	Labor for 4 hours for one trip per day	US\$	16.00
	Sub-total operating cost	US\$	72.66
O&M	Maintenance costs at 10%		7.27
	Total Operating Cost		79.93
	Add profit mark up of 5%		4.00
			83.93
	Depreciation at 80% spread over 5 years converted per trip		3.30
	Total cost including depreciation		87.23
	Add 15% Administrative costs ³		13.08
	Total average cost per trip		100.31

Source: SUWASA Survey of Exhauster Businesses in Juba, 2013

The average emptying fees of between US\$122 and US\$83 for septic tanks and pit latrines respectively are much higher than in any of the other cities in the Chowdry and Kone study. Other African cities had an average fee of US\$60 which is less than half that charged in Juba for septic tanks.

Even if operating costs escalated by 20 percent each year, without changing the price charged for emptying, a typical truck would still recover all costs and make a profit of US\$873,599 by the time the truck is fully depreciated at 80 percent over five years. This level of profitability is likely responsible for the extremely high number of trucks per person in Juba. For instance, Chowdry and Kone found average profit per truck of only US\$12,000 per year in Africa and US\$5,600 for Asia. The 2013 SUWASA Survey of Exhauster Businesses in Juba however suggests an annual profit per truck in Juba of US\$174,720.

3.3.3 Regulatory Arrangements for the Exhauster Trucks

Although there is currently no sanitation policy or sanitation law guiding the sub sector, local regulations for exhausters do exist. All tankers operating in the city are required to be registered and issued a sanitary license and a sticker by the Department of Environment and Sanitation in Juba City Council. A second regulation requires every exhauster truck to be painted red in order to distinguish them from water tankers which are supposed to be painted blue. Thirdly, regulation exists for the use of the wastewater lagoon where tankers dump the fecal sludge. Tankers pay two types of fees related to lagoon access; the first is payment of a toll fee designed as a form of compensation to Northern Bari Payam for hosting the lagoon. The second is payment of an emptying charge for each load discharged at the lagoon. The charges per truck vary from SSP10 to SSP50 from the smallest to the largest truck. Finally, use of the lagoon is regulated by controlling working hours which are from 07:00am to 5:00pm, Monday through Saturday, 07:00 am to 12:00 pm on Sundays and 07:00am to 10:00am on public holidays.

While it is encouraging that there is a regulatory framework in place, there is room for improvement:

- Firstly, while the high emptying fees reflect a thriving market, it is also indicative of little competition in the sector. The resulting price, which ranges between US\$83-US\$122, is high,

and could have the potential of discouraging households (particularly poorer ones) from mechanical emptying, thereby leading to increased manual exhaustion and other unsanitary and environmentally unacceptable practices. Where the poor cannot afford the service, regulators could look to facilitate market improvements and support for the poor including support of discounts or subsidies for the service, improvements in the competitiveness of bidding, or credit services. It is important that any external regulation does not result in a pricing regime that stifles competition or keeps the price too low to attract the private sector.

- Secondly, there is no enforcement of any public and occupational health standards (if these exist) as evidenced by the fact that no one on either the public or private sector side uses protective clothing, leading to unnecessary exposure of staff to water related diseases.
- Thirdly, there is no enforcement of any standards of influent entering and effluent leaving the Roton Lagoon. In order for the lagoon to perform optimally, it is essential to determine what quality of influent can be received and where necessary, to require those generating the waste to pretreat to the required level. It is also necessary to ensure that the effluent leaving the lagoon meets minimum standards to keep the environment safe and pollution free.
- Lastly, there is no requirement for the trucks to be parked in a designated area when not on an emptying call, for example at night. This means that the trucks are parked all over the city including residential areas, thereby posing potential public health and environmental risks. These risks are associated with potential leaks from the trucks especially since most of the trucks are secondhand; depositing fecal matter from cleaning processes and the fact that children are likely to play around or near the trucks. The challenge however is to ensure that wherever any such parking area is designated it is located in such a way that it does not impose unnecessary extra costs for the truckers and does not reduce competition.

3.4 Revenue Potential for the Public Sector from the Exhauster Trucks

The exhauster business in Juba constitutes a potentially reliable income stream for the public sector which can, and should, be directed toward reinvestment in the sector, allowing the public sector to more effectively expand and regulate the sanitation sector in Juba City. Table 8 shows revenue from the tankers collected by different government agencies based on fees applied in 2014.

Table 8: Revenue Collected from Exhausters by Public Agencies

Item	Revenue per Week (SSP)	Revenue per year (SSP)	Revenue per year (USD)	Agency Collecting Revenue
Sanitary License fee		206,250	66,532	Juba City Council
Toll Fee	41,541	2,160,000	696,774	Northern Bari Payam
Lagoon emptying Fee	33,108	1,721,629	555,364	Juba County
Grand Total		4,087,879	1,318,671	

The three public agencies jointly collect over SSP4 million (US\$1.3 million), which could potentially be sufficient to operate and maintain the lagoon effectively and even carry out limited infrastructure improvements. However, currently, the revenue is distributed among the three agencies without any commitment or clarity on how to use those funds to either maintain or expand operations of the lagoon.

A high risk of loss of the funds collected at the lagoon was noted. This is because the collector is allowed to keep the funds for a whole week and deposit them either on Friday or the following week in a special sanitation account held by the County. This risk is further heightened by the fact that the whole system is

cash based. Furthermore, even though the County has a Special Sanitation Account, the funds deposited therein are not protected for reuse in maintenance of the lagoon but are used for general purposes of the County. These funds are therefore not ring-fenced.

Finally, the basis on which the different charges are developed is not clear meaning that their linkage to cost recovery is not known. All these elements suggest that there is need to reexamine these financial transactions in order to introduce systems for the long term financial sustainability of the lagoon specifically and the sector more broadly.

3.5 Existing Sewerage Network

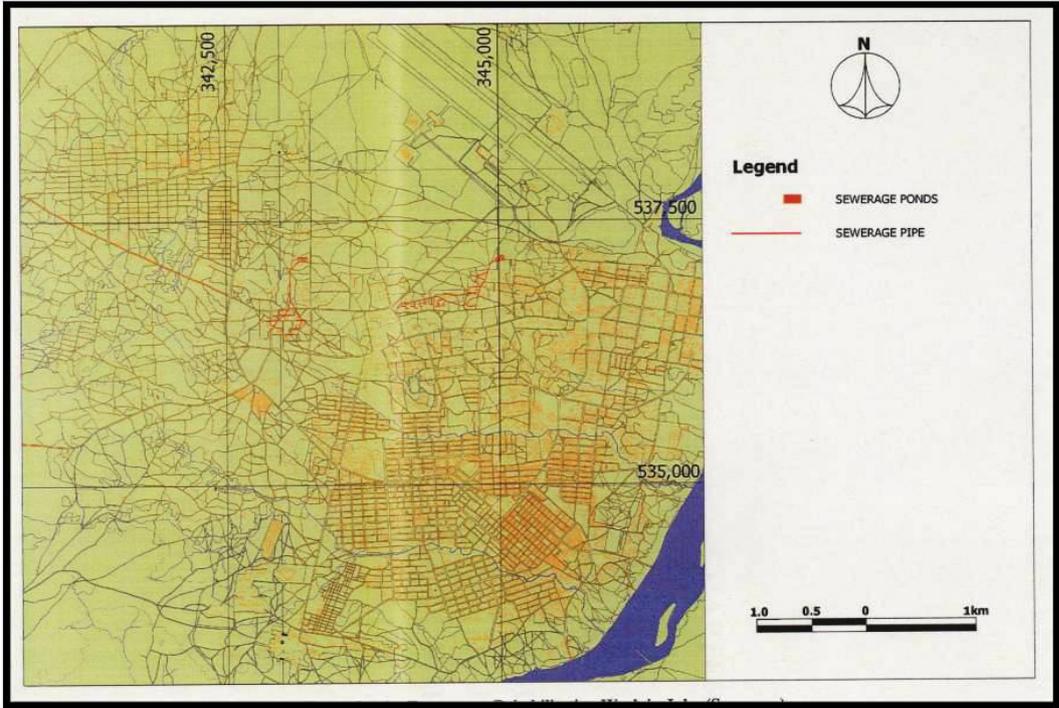
Juba City has two small sewerage systems. The first sewer system was established in 1972 but was dysfunctional for over 20 years until it was rehabilitated under the MDTF. This system collects wastewater from 90 ministerial houses and consists of 2.8 km sewers (diameters 100 mm, 150 mm and 200 mm) and terminates into a stabilization pond at Hai Amarat which has anaerobic, facultative and maturation ponds.

The second system was constructed in 1974 and was also dysfunctional for more than 20 years until it was rehabilitated under the MDTF in 2010. This system is for government offices at the ministerial complex and has about 2.3 km pipes (diameters 100mm and 150mm) discharging into a small stabilization pond which has an anaerobic pond, a facultative pond and a maturation pond, located in Kololo.

Physical inspection of both lagoons suggests that there is very little if any maintenance work and the ponds are not in very good working order.

The treated water from both ponds is discharged into the Bahr el-Jebel River and presently there is no system for monitoring the quality of this effluent.

Map 7: Existing Small Sewerage Networks in Juba



Since these sewer systems only serve government officials, it can be concluded that the city essentially has no public sewer network.

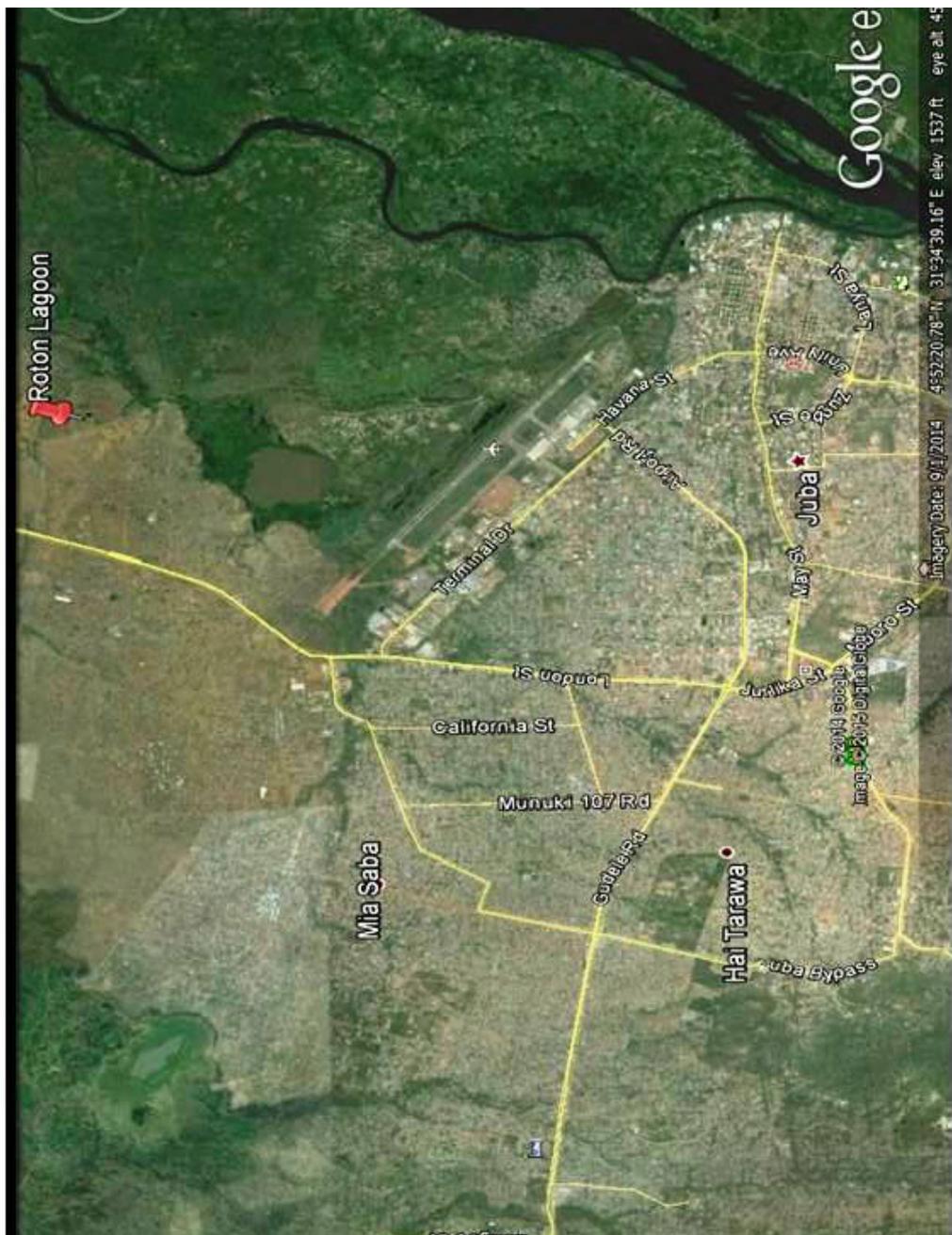
3.6 Treatment of Fecal Sludge in Juba: The Roton Wastewater Lagoon

3.6.1 Description

The Roton Lagoon located in the northern part of the city (Map 8) began operations in 2010 to receive wastewater and fecal sludge for treatment. The existing facilities consist of a receiving station, a grit channel, an anaerobic lagoon and a facultative lagoon. The lagoon site can accommodate future expansion of two additional anaerobic ponds, one additional facultative lagoon and a series of maturation ponds (Map 9).

Lagoon technology is an ideal method for treating sewerage and fecal sludge in Juba. There are minimal electrical and chemical requirements and the facilities can be maintained with minimal labor and equipment compared to other treatment technologies and in the case of Juba, the existing site already has land planned for expansion.

Map 8: Location of Roton Lagoon



The anaerobic ponds are three meter deep basins designed to reduce settleable solids, digest organic solids, and consume soluble organic material through anaerobic biological processes. The facultative pond uses a mixture of aerobic, anoxic and anaerobic zones to further remove soluble organic material and some nitrogen from the water. When properly designed and operated, this type of configuration is effective at removing Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS) and fecal coliforms.

As previously noted, the Roton Lagoon was only partially constructed against the original design specifications. The design for the complete Lagoon incorporates additional anaerobic and facultative ponds as well as maturation ponds which act to further remove suspended solids and fecal coliforms.

Site visits to the Roton Lagoon revealed that the above-ground, exposed structures and facilities were in good condition. The anaerobic basin had a significant amount of large debris such as plastic bottles that should have been screened out prior to the lagoon. As a result of this accumulation the influent appeared to be passing straight through the basin to the facultative ponds instead of being dispersed in the basin. Piles of grit and sand adjacent on the banks of the lagoon indicate that the basin does get some cleaning. The facultative pond appeared to be properly functioning. Algae that is crucial to the successful removal of pollutants was present in the pond but not in such a significant amount that it seemed to be contributing to TSS in the effluent.

Effluent from the facultative pond is discharged into a stream that ultimately discharges to the Nile River. The effluent is however generally reddish in color. Additional testing is needed to determine the source of the discoloration.

The site also has a laboratory building fully constructed but which has never been equipped.

3.6.2 Sewerage Quality

Grab samples were taken on two separate occasions to obtain data on the water quality at various points in the treatment process. The samples were shipped to a reputable laboratory in Nairobi, Kenya for analysis. Table 9 summarizes the results and Table 10 compares the results against Environmental Health and Safety Standards for wastewater discharges published by the World Bank.

Table 9: Sewerage Quality Sampling

Parameter ⁽¹⁾	Receiving Area	Anaerobic Lagoon Effluent	Facultative Lagoon Effluent
Sample event: March 2014			
pH	7.24	7.2	7.68
Suspended Solids	371	261	655
Conductivity	3840	3560	3790
BOD	365	328	216
COD	912	820	653
Potassium	21.8	20.6	18.9
Ammonium	190.3	160.05	152.03
Copper	0.23	0.46	0.02
Nickel	0.172	0.191	0.353
Lead	0.005	0.004	0.004
Arsenic	0.07	0.03	0.03
Cadmium	ND	ND	ND
Total Nitrogen	330	190	190
Total Phosphorous	73.1	95.5	79.5
Fecal Coliform	16	16	9.2

Sample event: July 2014			
pH	8.44	8.01	8.58
Suspended Solids	488	654	643
Conductivity	4400	4120	3090
BOD	384	466	184
COD	712	1165	460
Potassium	61.3	85.9	79.6
Ammonium	65.89	190.99	120.03
Copper	0.04	0.29	0.11
Nickel	0.139	0.256	0.226
Lead	0.004	0.004	0.003
Arsenic	0.03	0.02	0.02
Cadmium	ND	ND	ND
Total N	180	210	165
Total Phosphorous	23.9	77	68.1
Fecal Coliform	5.2	9.2	5.2

Notes: (1) All units in mg/l except for Fecal Coliform in count per ml. ND = Not Detected

Source: SUWASA Assessment of Roton Lagoon in Juba, 2013/14

In reviewing the data in Table 9 it is important to note that the data is based on grab samples that were taken in the absence of a specific sampling protocol. The results therefore should be considered as only a generalized single snapshot of overall quality and a more rigorous sampling program may yield different results. Nevertheless, based on the data there is evidence that the Roton Lagoon is somewhat effective at removing BOD and Total nitrogen. No design effluent data standards were available. However, Table 10 shows that standard effluent discharge limits as set by the World Bank who financed construction of the lagoon are not being met. The high suspended solids in the effluent may be due to the presence of algae and not sewerage pollutants.

Table 10: Effluent Quality Comparison

Parameter	Roton Effluent	Effluent Standards – World Bank
pH	7.68 – 8.58	6 – 9
BOD	184 – 216	30
COD	653 – 460	125
Total Nitrogen	165 – 190	10
Total Phosphorous	68.1 – 79.5	2
Total Suspended Solids	643 – 655	50
Total Coliform Bact.	5.2 – 9.2	400

Source: SUWASA Assessment of Roton Lagoon in Juba, 2013/14

Additional sample locations include sites 1km and 2km downstream of the effluent discharge point. Further samples at the stream's entrance to the Nile and at two points in the Nile upstream of the stream's entrance were taken in July 2014. The data are provided in Table 11 below.

The stream data is highly erratic with some pollutant concentrations exceeding the raw wastewater quality. In addition to the sampling limitations mentioned above, it is possible that the presence of livestock and other environmental factors are heavily influencing the water quality at these locations. For future sampling of this area it is recommended to obtain samples upstream of the effluent discharge point to establish a background level of pollutants for the stream.

The data obtained from the Nile presents a general idea of the water quality around Juba. However, other contributions to the river as it flows past Juba obscure any particular influence that may be caused by the Roton effluent.

The sewerage quality received at the lagoon is greatly dependent upon where the exhauster trucks received their load. A truck coming from a hotel or apartment building that is fully plumbed is likely to have sewerage that is more dilute than a truck that has been filled with fecal sludge from pit latrines. As a result, limited grab samples at the receiving station are not likely to capture the full range of wastewater quality entering the lagoon. The pollutant concentrations from receiving station data presented in Table 9 are higher than what would be expected from a location with high access to water but also significantly less than septage or pit latrine concentrations.

Table 11: Stream and River Quality Data

Parameter ⁽¹⁾	1 km down-stream from discharge	2 km down-stream from discharge	Stream entrance to Nile River	Nile river 2 km upstream of stream entrance	Nile River up-stream of Juba
Sample event: March 2014					
pH	7.57	7.62	No Sample	No Sample	No Sample
Suspended Solids	659	673	No Sample	No Sample	No Sample
Conductivity	3880	3790	No Sample	No Sample	No Sample
BOD	270	264	No Sample	No Sample	No Sample
COD	674	660	No Sample	No Sample	No Sample
Potassium	19.1	20.3	No Sample	No Sample	No Sample
Ammonium	158.9	159.78	No Sample	No Sample	No Sample
Copper	0.06	0.02	No Sample	No Sample	No Sample
Nickel	0.368	0.370	No Sample	No Sample	No Sample
Lead	0.002	ND	No Sample	No Sample	No Sample
Arsenic	0.05	0.03	No Sample	No Sample	No Sample
Cadmium	ND	ND	No Sample	No Sample	No Sample
Total Nitrogen	178	181	No Sample	No Sample	No Sample
Total Phosphorous	80.4	77.9	No Sample	No Sample	No Sample
Fecal Coliform	5.1	9.2	No Sample	No Sample	No Sample
Sample event: July 2014					
pH	8.51	8.53	7.94	8.13	8.12
Suspended Solids	814	678	208	48	29
Conductivity	3100	3080	65.7	215	209
BOD	664	183	17.6	5	2
COD	1668	458	44	12	5
Potassium	114.9	112.87	1.4	10.7	10.3
Ammonium	114.9	112.87	1.4	0.2	0.18
Copper	0.29	0.20	0.03	0.03	0.04
Nickel	0.198	0.227	0.11	0.16	0.013
Lead	0.005	0.001	ND	ND	ND
Arsenic	0.03	0.01	0.01	0.03	0.03
Cadmium	ND	ND	ND	ND	ND
Total N	110	135	8	4	1
Fecal Coliform	9.2	5.2	2.2	ND	2.2

Notes: (1) All units in mg/l except for Fecal Coliform in count per ml. ND = Not Detected

Source: SUWASA Assessment of Roton Lagoon in Juba, 2013/14

3.6.3 Sewerage Quantity and Capacity Analysis

The Roton Lagoon is not equipped with a flow measuring device. However, a survey of exhauster trucks conducted over a one week period in July 2014 indicated that the lagoon is receiving about 2,300 m³/day of fecal sludge.

Detailed engineering design calculations for the Roton Lagoon are not available. The design capacity of the existing Roton lagoon facilities was estimated using available design drawings and the design criteria in Table 12. Roton Lagoon has a design capacity of approximately 3,300m³/day. Based on these numbers, the Roton Lagoon is operating at approximately 70% of the existing capacity. With the future expansions planned for the site, the total design capacity (existing and future facilities) is estimated at between 6,500 and 9,800 m³/day.

Table 12: Roton Lagoon Capacity Analysis Criteria

Criteria	Existing Facilities	Future Facilities
Influent BOD (kg/m ³)	0.40	0.40
Anaerobic Lagoon		
Loading Rate (kg BOD/m ³ /day)	0.20	0.20
Volume (m ³)	6627	13250
Design Capacity (m ³ /day)	3,313	6,625
Facultative Lagoon		
Loading Rate (kg BOD/ha/day)	100	100
Area (ha)	3.6	4.3
Design Capacity (m ³ /day)	3,300	3,567
Maturation Ponds		
Residence Time (days)	NA	5
Volume (m ³)	NA	41,250
Design Capacity (m ³ /day)	NA	8,250

Source: SUWASA Assessment of Roton Lagoon in Juba, 2013/14

3.6.4 Conclusions on Roton Lagoon

Although the Roton Lagoon is operating at 70% of its constructed capacity, it is not producing the quality of effluent that would be expected from a properly operated and maintained facility. While it seems that there are attempts at cleaning the anaerobic pond, the current condition of the lagoon is indicative of little to no maintenance that has led to accumulation of debris and large solids in the anaerobic pond. It is also likely that the accumulation of grit in the ponds is limiting the available treatment volume and reducing the effectiveness of the pond. In order to improve functionality of the lagoon the following additional activities are recommended:

1. Comprehensive influent and effluent sampling for BOD, COD, SS, TN, TP and Coliforms;
2. Extended exhauster truck surveys to further document influent flow;
3. Investigation of the extent of grit buildup in the anaerobic pond and removal of debris present.

Given the growth occurring in Juba, the remaining 30% available capacity in the existing lagoon will quickly be utilized. Therefore, a general recommendation is made to immediately commence with activities to expand the lagoon to its full capacity.

4.0 Policy, Regulatory, and Institutional Framework for Urban Sanitation

4.1 The Water Policy and the WASH Strategic Framework

In order for the Juba City sanitation service chain to function properly, government needs to create an enabling environment for effective service delivery including clarification of institutional roles and responsibilities and financing arrangements that support these institutional roles. This chapter therefore describes the institutional and regulatory arrangements existing in the sub-sector:

Urban sanitation in South Sudan is currently guided by two main pieces of government policy papers, namely, the Water Policy of 2007 and the (Water, Sanitation and Hygiene) WASH Strategic Framework of 2011. The policy is guided by a number of principles key amongst them are: an integrated approach in the planning and development of piped water supply and waste disposal infrastructure; separation of regulatory from service delivery functions; and decentralization of regulation, delivery and management of Urban Water Supply and Sanitation (UWSS) to the lowest appropriate level in accordance with the principle of subsidiarity.

The WASH strategic framework on the other hand is intended to operationalize the Water Policy of 2007 and ensure its implementation through effective and technically sound strategic approaches, improved capacity and involvement of all stakeholders. The framework elaborates the UWSS function as one responsibility under the overall direction of the Ministry of Electricity, Dams, Irrigation and Water Resources (MEDIWR) with a central role in policy making, management and coordination. The framework proposes further that the SSUWC should have a mandate to manage urban sanitation (including sewerage systems).

The framework also calls for promotion of private sector participation including regulating sludge management and exploring market based and fiscal modalities for incentivizing private actors.

The provisions of both the National Water Policy and the WASH Strategic Framework are expected to be given legal basis through the proposed Water Bill 2011 which is yet to be enacted into law.

At the international level, the Government of South Sudan is one of the global partners of Sanitation and Water for All. As such, it makes public commitments to the sector at biannual High Level Meetings (HLM). At the 2014 HLM, South Sudan made six commitments including those which are relevant to urban sanitation:

The MEDIWR, in collaboration with partners and stakeholders, will have initiated by 2016 the deployment of mechanisms that ensure transparency and accountability of all financial resources allocated to the WASH sector in South Sudan.

MoFCIEP, in collaboration with MEDIWR, will establish and ensure a minimum allocation for sanitation and hygiene of 0.2% of national expenditure by 2016.

The challenge is for the GoSS to turn these commitments into actions on the ground.

4.2 Existing Institutional Arrangements

Currently four ministries at national level, two at Central Equatoria State level, Juba County and Juba City Council have a role in urban sanitation. South Sudan Urban Water Corporation (SSUWC) is indirectly involved.

4.2.1 Ministry of Electricity, Dams, Irrigation and Water Resources

The Ministry of Electricity, Dams, Irrigation and Water Resources of the Republic of South Sudan (RSS) is responsible for formulating policy on water supply, planning and establishment of the water supply facilities related to urban water. The MEDIWR develops infrastructure which it hands over to South Sudan Urban Water Corporation (SSUWC) to manage on behalf of the government.

Although almost all activities are focused on water supply, the ministry is however also involved in urban sanitation. At the national level, the Ministry has prepared the Urban Water Supply, Sanitation and Hygiene (UWSS) Subsector Investment Plan (2013-2018) which although largely focused on provision of water supply, also includes provision for exhauster tankers; wastewater treatment facilities as well as subsidy schemes for construction of household toilets and hygiene and sanitation public awareness customer surveys for 3 cities, 22 major towns, 25 minor towns and 42 small towns.

At the local level, the Ministry is piloting the joint provision of water and sanitation services through the Yei Water and Sewerage Company (YWSC) which is constructing and managing ablution blocks funded by GIZ. Similarly in Juba, the Ministry is working with GIZ to construct one public toilet under the SSUWC (2 public toilets are being constructed under the Juba City Council).

4.2.1.1 South Sudan Urban Water Corporation

South Sudan Urban Water Corporation (SSUWC) established by a Decree in 2007 and by Presidential Order in 2011, is mandated as the official urban waterworks of South Sudan and the organization responsible for providing water supply services to urban citizens of South Sudan. SSUWC has its head office in Juba and six branches in Juba, Wau, Maridi, Malakal, Bor, and Renk. The Corporation is headed by a Managing Director and has a Board of Directors which is chaired by the Minister for Electricity, Dams, Irrigation and Water Resources. The main function of the SSUWC is production and distribution of clean water. Currently, they have no mandate and no role in urban sanitation at all.

4.2.2 Ministry of Lands, Housing and Physical Planning

The Ministry of Lands, Housing and Physical Planning (MLHPP) is mandated to develop policies and programs for capital investments and provision of urban sanitation services in the state capitals and other major towns in South Sudan. Within the ministry, urban sanitation activities are the mandate of the Directorate of Urban Sanitation. One of their key functions is to provide or ensure the provision of suitable schemes for sewerage disposal and treatment in housing schemes and urban areas. In this regard, key activities that the directorate has managed to date in Juba include rehabilitation of ministerial complex oxidation ponds at Kololo and ministerial housing oxidation ponds at Hai Amarat; construction of the Roton Wastewater Lagoon in Juba town; and construction of three ablution blocks in Juba town. The directorate also purchased the six exhauster tankers that were handed over to the three payams of Juba, Munuki and Kator. Management and operation of the Roton Lagoon was handed over to the Commissioner of Juba County, Department of Public Health in Central Equatoria State. All these works were funded under the Multi Donor Trust Fund (MDTF) administered by the World Bank and completed in 2010. The Ministry is also responsible for formulating policy, standards and regulations on urban planning and urban land management. The directorate has five engineers who work only on maintenance of government and ministerial sewer facilities.

4.2.3 Ministry of Health

The Ministry of Health is responsible for hygiene promotion and emergency intervention provided for in the Health Policy. The Ministry is expected to raise awareness of the potential health hazards related to lack of adequate sanitation and hygiene services. The ministry has 9 directorates of which 2 are most relevant to sanitation namely:

1. Directorate of Preventive Health Services under which is the Department of Environmental Health.
2. Directorate of Primary Health Care under which the Department of Health, Education and Promotion is responsible for social mobilization and hygiene promotion.

These two directorates act as a lead agency in community outreach programs on all diseases including water borne ones like cholera. They coordinate preparation of messages and campaign approaches and then supervise the State Ministry of Health, Juba County and Juba City Council who do actual community outreach.

4.2.4 Ministry of Environment

The Ministry of Environment which was created in 2010 is responsible for environmental protection. The ministry has six directorates including the Directorate of Environmental Management under which are the Departments of Pollution Control, Waste Management and the Department of Environmental Impacts. The Waste Management Department is supposed to prepare and enforce environmental guidelines while the EIA team is supposed to enforce Environmental Impact Assessment Studies, control waste management, carry out inspections and provide technical assistance and advice to developers. Operations of the ministry are currently hampered by the fact that there is no environmental law to compel enforcement although a draft bill on environmental management has been prepared.

4.2.5 Organization of Sanitation at Central Equatorial State Level

South Sudan has 10 states of which Central Equatorial State (CES) is housing the seat of government in Juba. Each state is administered by a State Governor who is an elected official. The governor is assisted by the Deputy Governor and State Ministers who are appointed by and report directly to the Governor. Not all national level ministries are represented at the state level and those that are represented do not necessarily have the same mandates or names as those at national level. Amongst the ministries that have some role in urban sanitation, only the Ministry of Lands Housing and Physical Planning and the Ministry of Health, are represented at the Central Equatoria State level.

4.2.5.1 Ministry of Infrastructure and Rural Water

In Central Equatoria State, the Ministry of Lands Housing and Physical Planning, is called the Ministry of Infrastructure and Rural Water. The ministry does not play any direct role in urban sanitation. However, the ministry is responsible for land administration including issuing of title, undertaking land surveys, and urban planning. The Ministry of Electricity, Dams, Irrigation and Water Resources although not represented in Central Equatoria State, seconds engineers to the Water and Sanitation Department in the Ministry of Infrastructure and Rural Water. This department only deals with urban water supply issues in the county and sanitation in the rural and peri-urban areas.

4.2.5.2 Ministry of Health, Sanitation and Environment

In Central Equatoria State, the Ministry of Health also assumes responsibility for sanitation and environment. The Ministry has three Departments, these are:

- Department of Health: responsible for primary and curative health including training and recruitment of medical personnel;
- Department of Sanitation: responsible for liquid and solid waste management, food safety, inspection of premises for sanitary issues, animal slaughter and hygiene promotion;
- Department of Environment: responsible for environmental protection including developing and enforcing environmental policies and laws.

The ministry carries out oversight and supervisory functions whilst implementation is carried out at county, city and block level.

4.2.6 Organization of Sanitation at Juba County Level

Juba County has 13 payams, excluding the three that make up the City of Juba. The County is headed by the County Commissioner who is the representative of the State Governor in the County and is accountable to the Legislative Council. The Commissioner is responsible for ensuring service delivery in the County. For sanitation activities, the County has a Department of Water and Sanitation and a Department of Health. The Department of Health follows up sanitation and hygiene issues in the County. The Water and Sanitation Department focuses on water supply and sanitation in the County. The department of health is headed by a Director of Public Health who reports to the Commissioner, but is employed and seconded by the Ministry of Health, Sanitation and Environment at the Central Equatoria State.

Even though the County has no direct responsibility over sanitation matters in the city of Juba, currently, Juba County is working as a partner to Juba City Council because of the location of the Roton Wastewater Lagoon in Northern Bari Payam which is a rural payam administered directly by the county and not the council. This involvement of Juba County came about due to the fact that at the time construction of the lagoon was completed, Juba City Council did not exist and the entire area was therefore under the jurisdiction of the County. The key functions of the County include the day to day management of the Roton Wastewater Lagoon including setting and collection of sludge emptying fees and administration of the sanitation account into which these fees are deposited. Until September 2014, the County was also responsible for regulation of the private exhauster businesses including at the beginning of each year, directing on a rotational basis, one of the three city payams/ block councils (Juba, Munuki and Kator) to inspect, register and issue sanitary licenses to all the exhauster trucks operating in the city. This function was however taken over in October 2014, by the Department of Environment and Sanitation within Juba City Council.

4.2.7 Organization of Sanitation at Juba City Council Level

Juba City Council is a corporate body divided into Block Councils and Quarter Councils. Juba has three Blocks (Juba, Munuki, Kator) and 55 Quarter Councils. Juba City Council is headed by the Mayor who is the representative of the State Governor in the City Council and is accountable to the Legislative Council in his discharge of duties. Powers and functions of the mayor include organizing the executive institutions of the city to perform their functions diligently, execute policies and by-laws passed by the legislative council, initiate legislation to the legislative council and sign them into law, mobilize and organize the general public to play an effective role in service delivery and coordinate activities of government and all other actors in the city.

Under the Local Government Act of 2009, Juba City Council like all other local governments has many powers related to sanitation the key ones being: provision of basic services, acquisition of land from relevant authorities for use for service provision and development, regulation of business trade

licenses, working conditions, town and rural planning; public health policy, regulation and management; urban development planning and management; delivery of primary and secondary services; disaster preparedness and epidemics control management; electricity generation, electric and water supply and waste management; environmental protection, conservation and management; planning, preparing and executing projects for the promotion of environmental health; undertaking public cleaning and disposal of refuse, human and animal solid wastes; establishing public toilets and laying down the rules for using and monitoring the same and specifications for private toilets; disseminating health awareness including HIV/AIDS (Local Government Act, Schedules I, II, III).

Currently, Juba City Council has two departments with some possible role in sanitation namely, Department of Public Health and Department of Environment and Sanitation. The latter was created in 2014 and has since taken over responsibility for solid waste management in the city including garbage collection and public health inspections. These tasks were previously performed by the Department of Public Health. From October 2014, the Department of Environment and Sanitation also took over the function of registering and issuing sanitary licenses to exhauster tanker operators in the city. Given this new dispensation, it is not clear what the role the Department of Public Health is supposed to be playing and this needs to be considered.

It is worth noting that at present, Juba City Council does not employ any technical staff as it has not yet been given the necessary legal mandate to do so. Therefore all technical staff in the two departments, including the directors, are employed by the Ministry of Health, Sanitation and Environment (CES) and seconded to the Juba City Council, including at Payam level. The Ministry also pays salaries of these seconded staff, although the city council provides all necessary tools and equipment to facilitate their work. This has a big impact on the council's ability to undertake activities as it limits control of the council over these workers due to their limited accountability.

For its part, the city council currently employs only laborers and administrative officers (Table 13)

Table 13: Public Health and Sanitation Staff at Juba City Council

Technical Staff				Laborers (Employees of the Council)			
Payam/Block	Public Health Officers	Assistants	Total	Environment/Sanitation Officers	Permanent Workers	Casuals (Local)	Total
Juba Block	8	3	11	3	54	60	134
Kator Block	10	4	14	3	29	106	135
Munuki Block	8	6	14	4	47	55	102
Total	26	13	39	10	130	231	371

Source: SUWASA Sanitation Institutions Mapping 2014
 Note: Ministry of Health has also seconded the Directors of Public Health and Environment together with their assistants who are based at the Juba City Council head quarters

At the Block level, each of the three blocks has a Department of Health which houses the public health unit, as well as a Department of Public Works which has the engineering unit. In the block, the deputy director for public health is in charge of liquid waste management. Currently each block owns and is managing two exhauster trucks which were procured by the MLHPP under the MDTF. The budget for managing the exhausters comes from the Block budget which is funded from local levies, taxes, licensing charges etc. The Block is also responsible for maintenance of the trucks. The exhauster trucks are used purely for business purposes and are therefore a source of revenue for the Blocks. The Juba city council through the leadership team (comprised of the mayor, his two deputies, the directors of the 3 blocks and

all heads of departments) makes decisions on pricing of the exhauster services provided by the Block Council. The Block Councils are responsible for management and supervision of public toilets.

In order to carry out its functions, under the Local Government Act, Juba City Council is permitted to generate its own revenues, obtain government grants, community contributions and donations as well as loans or to seek support from international agencies and organizations for funding and implementation of its programs and projects. Presently however Juba City Council does not receive any form of grants from the national government. Rather, the City generates its revenues from taxes, local fees, garbage fees, administrative and environmental fines, and general licenses. A major positive is that the City Council is allowed to keep all revenues that are collected within the city and does not remit anything to either a national or state government ministry. This means that the city has significant control over the resources that are generated in the city. There is therefore potential for the city council to generate and expend revenues on sanitation improvements in the city. The key challenge is for the City to clearly define those revenue sources and ensure that all revenues generated from sanitation activities are ring-fenced and reinvested in the sector.

4.3 Conclusions on Institutional and Legislative Arrangements

From the foregoing, it can be concluded that the Government of South Sudan has a policy framework in place for management of urban sanitation as an integrated service with piped water supply and also provision for participation of other relevant key actors including the private sector.

It is however in this very policy framework that the main conflict between the Ministry of Electricity, Dams, Irrigation and Water Resources and the Ministry of Lands, Housing and Physical Planning can be seen. Even though the mandate for urban sanitation lies with MLHPP, it is rather MEDIWR that has so far developed the policies, legal framework and investment plans for the subsector. It is however important to note that these policies are yet to be translated into reality. There is therefore room for the subsector to engage in a dialogue to clarify and streamline the roles and responsibilities of these two ministries.

The policy also provides for participation of other relevant key actors in particular the private sector. This is crucial in the case of Juba which given the lack of a sewer network will for the foreseeable future, continue to rely on onsite sanitation facilities and related mechanized emptying. This service is currently being provided by the private sector and should continue as such. The long term viability of this service is probably much more assured with the private sector and also saves the government money.

The Local Government Act together with the WASH strategic framework provides a framework for service delivery at the lowest level. In the case of Juba, these policy provisions firmly position the responsibility for sanitation services delivery as a responsibility of the Juba City Council. These policies however need to be translated into reality to empower Juba City Council to be able to carry out its sanitation tasks effectively. The following are particularly pertinent.

To begin with, the City Council currently, does not have sufficient technical capacity to carry out most of the associated tasks. The fact that the City Council does not employ technical staff but relies fully on seconded staff from the Ministry of Health is particularly noteworthy. This arrangement means that even though the council may not have its own staff, it can rely upon staff from state ministries for technical matters. However, the fact that the mayor cannot hire and fire his own technical staff presents a challenge in his ability to discipline and get full accountability from these staff. This situation is further compounded by the fact that the mayor does not even pay salaries of these staff. If the city has to take full control of sanitation in the city, then it will be necessary that the process for enabling the city council employ and pay its own technical staff should be prioritized.

Secondly, it will be necessary to clarify and define the roles of the two departments namely Public Health and Environment and Sanitation which seem to have similar tasks. Presently, the council seems to be investing significant resources and energy into the Department of Environment and Sanitation which has since taken over all solid waste functions as well as the registration of tankers. It may be worthwhile to continue the process of centralizing the sanitation function within this department and determining either new functions for the Department of Public Health or doing away with it.

Thirdly, Juba County is currently involved in the management of the Roton Lagoon which serves the City. This came about due to the fact that when construction was completed, Juba City Council did not exist and the entire area was therefore under the jurisdiction of the County. Currently, the county does not have sufficient technical capacity to manage the lagoon. In addition, there is no evidence that funds being collected from the exhauster tankers are being re-invested in the lagoon. The fact that the city now exists and the bulk of the fecal sludge being brought to the lagoon is emanating from the city means someone needs to re-examine the viability of the current arrangements.

Fourthly, since the private sector has responded very positively to provide mechanized exhauster services, it will be important for Juba City Council to reconsider whether it wants to continue playing the role of both provider of exhauster services, through its Blocks, whilst at the same time being regulator of those same services. Considering the issues the council is experiencing in maintaining the trucks and also using other African countries as an example, it would be wise for the council to focus its resources on enabling and regulating the private sector rather than being directly involved in service provision.

Finally, the institution that would form the natural home for management of wastewater treatment facilities and piped sewerage systems due to availability of technical staff, and responsibility for piped water supply, namely the South Sudan Urban Water Corporation, is currently not involved in sanitation activities. Its future role has to be seriously considered, particularly as the city begins to develop piped sewer networks. Table 14 summarizes key institutional issues in the sanitation sector in Juba, South Sudan.

Table 14: Key Issues in Institutional Arrangements for Sanitation in Juba

Institution	Mandate	Current sanitation Roles Played in Juba	Policy/ legislative Provisions	Comment/ Analysis
<i>Ministry of Lands, Housing and Physical Planning</i>	Urban sanitation policy and development of urban sanitation infrastructure	Management of ministerial and government sewer system including two associated lagoons		
<i>Ministry of Electricity Dams Irrigation and Water Resources</i>	Policy and development of Urban water supply infrastructure Policy and development of rural water supply and sanitation	None	Assigned overall responsibility for urban and rural WASH in the national water policy and WASH Strategic framework	Have direct control and influence over SSUWC and would therefore have responsibility for urban sanitation infrastructure development under the strategic framework. The ministry therefore has the biggest conflict with MLHPP
<i>Ministry of Health (RSS)</i>	Policy and implementation of hygiene promotion and public health campaigns	Hygiene promotion and social mobilization for water borne outbreaks		
<i>Ministry of Environment</i>	Policy and enforcement of environmental protection		Developing environmental management law	Key issue is to get the law passed so that the ministry has the tools to enforce environmental standards
<i>Ministry of Health (CEG)</i>		Provide all technical staff to Juba city council and county		Current strong partner to the city through provision of technical staff but limited to public health staff.
<i>Juba County</i>	Management of service delivery in Juba county	Management of Roton wastewater lagoon and regulation of exhausters tankers		Manage and operate the Roton lagoon Have insufficient technical manpower to manage the Plant.
<i>Juba City Council</i>	Management of service delivery in Juba City	Licensing of exhausters tankers Collection and transportation of fecal sludge	Mandated to provide basic services under the Local Government of 2009	Have legal mandate over sanitation but no technical expertise in-house to manage facilities. However, under current arrangements, they could get technical staff seconded from the ministries at CEG level. Duplication of registration by Block councils may constrain proper regulation of the exhausters tankers
<i>South Sudan Urban Water Corporation</i>	Provision of water in Juba city	None	Assigned overall responsibility for urban Water and sanitation in the water policy and WASH Strategic framework	Natural home for piped sewerage systems and related treatment Plants due to availability and access to technical expertise.

4.4 Summary of Key Sanitation Issues

4.4.1 Containment of Fecal Sludge

At the household level, there is still a large number of households (45 percent) without access to improved sanitation. Construction standards of existing toilets are also not very appropriate for the type of cleansing preferred by the community and also for mechanized emptying. There is therefore a need to assist and compel households to properly construct, use and maintain individual toilets. There is also a clear need for hygiene promotion to ensure the full benefits of improved sanitation. Aside from the households, there is also a need to facilitate and enforce proper design and construction of public toilets as well as enforce good maintenance and hygienic practices.

4.4.2 Transportation of Fecal Sludge

Juba lacks a piped sewer network with only 2 percent of the population having such access. However the County has a very active and relatively profitable mechanized exhauster service sector, accounting for over 96 percent of fecal sludge handled. Given that the city also has a very limited water network, transportation of fecal sludge in Juba will in the foreseeable future continue to depend on exhauster trucks. Basic regulation of the tankers is in place but is limited to issuance of operational licenses and disposal permits. There is therefore need to ensure that this service is adequately capacitated and regulated to protect both public health and the environment.

4.4.3 Treatment of Fecal Sludge

Sludge treatment is provided at the Roton Wastewater Lagoon located outside of the city boundaries and at two smaller lagoons within the city limits. The capacity of the existing treatment plant is adequate for the current estimated flows received. However, it is expected that the installed capacity will be reached by 2020 and there needs to be immediate consideration of the expansion of the plant to meet the original design specifications. The lack of adequate management has meant that the capacity is reduced and effectiveness of treatment processes is inadequate causing environmental and health risks that need to be remedied.

4.4.4 Institutional Arrangements

At present, there is a conflict in roles and responsibilities between the two key government ministries which need to be resolved to make the subsector attractive to both donors and the private sector. Clarity of these roles would help the government to identify a strategy toward fulfilling its policy commitments to the sector. At the local level, whilst Juba City Council has the mandate over sanitation, there is still need to acknowledge the necessity of adequate sanitation in Juba City, create awareness of its importance with the population and put the appropriate framework in place to build and meet demand for appropriate and regulated services. Over the longer term, the role of SSUWC in regard to sanitation should be considered. The utility has no legal mandate for sanitation provision, but it does have the majority of the government's engineering expertise and a structure for service provision which would enable joint development and management of water and sanitation.

4.4.5 Financing Arrangements

Currently, there is no apparent government funding to the sector. The sector is reliant on the private sector both for investment in exhauster tankers and the bulk of construction of public toilets. Households pay for construction of their private toilets. In addition, the US\$1.3 million collected in licenses and fees by the public sector from exhauster tanker operations is not ring-fenced or reinvested

in the sector. This reduces confidence of both donors and the private sector to invest in the sector. There needs to be fulfillment of the GoSS commitment to allocate appropriate budgets to water and sanitation. The sector cannot remain reliant on the private sector for service delivery unless a regulatory framework is put in place. Private sector alone cannot be relied upon to ensure affordable pricing, equitable coverage or adhering to quality standards. The private sector is, though, a valuable partner in meeting demand. The government should be expected to meet its end of the bargain to customers by ensuring that it makes good use of revenues collected to maintain and expand the lagoon to keep pace with the population growth. Without this commitment, the Government risks new cholera outbreaks and the financial cost of on-going poor health of Juba's population due to open defecation, diarrhea and the spread of other diseases. There needs to be additional transparency around all the cash-based financial transactions in the sector and better mechanisms for planning and accountability.

5.0 The Juba City Sanitation Investment Plan, 2015-2030

This section presents proposed interventions to be undertaken over the next 15 years (2015-2030) to address ongoing sanitation issues and to expand and improve services in Juba City going forward. The plan prioritizes investments in five year intervals namely 2015-2020; 2021-2025; and 2026-2030. The interventions are structured around the three components of the sanitation supply chain namely 1) containment of fecal waste, 2) collection and transportation of fecal waste, and 3) treatment/ reuse of fecal waste. The plan is organized into three sections. The first section outlines the strategic approach adopted for the Investment Plan including rationale for this approach. The second section gives projections on both population and fecal sludge generation which form the basis of the Planning. The third section describes the sanitation interventions in each of the 5 year intervals.

5.1 Strategic Approach for the Juba City Sanitation Investment Plan

The Investment Plan builds from key strategic principles for each of the components on the fecal sludge management chain.

5.1.1 Containment of fecal waste

5.1.1.1 Household Toilets

Principle 1: Demand driven and household financed. Following best practice across the continent, the plan proposes that provision of household toilets should be on a demand driven approach based on a sanitation promotion program to encourage property owners/landlords to invest in their toilets. Financing for household toilets should be the responsibility of the property owners/landlords. This is to minimize the need for government subsidy from limited public resources. With appropriate demand and supply in place, people are willing to pay for appropriate affordable products at the household level.

Principle 2: Limited and targeted subsidies only as necessary: Recognizing that there will always be a segment of the population in Juba that may not have the capacity to pay for construction of a toilet and in the interest of public health, the possibility of limited and targeted subsidies is also to be considered. This must however be considered very carefully to avoid derailing the demand driven approach. If subsidized financing is available, it should be considered how best to target that – whether to less affordable infrastructure, coverage of the poorest of the poor, or stimulation of the market and demand.

Principle 3: Onsite technology suitable for exhauster emptying: Because of the lack of a sewer system, the plan proposes the adoption of onsite technologies that are suitable for exhauster emptying. This will not only allow homeowners to have access to good toilets but also ensure that there is not a proliferation of manual emptying. This requires some clarity and consistency in design standards for greater efficiency as well as enforcement of the adherence to standards.

5.1.1.2 Public Toilets

Principle 1: Public Private Partnership: It is important to ensure continued construction of public toilets by both the public and private sector as a means of leveraging resources to the subsector. Wherever

possible, the private sector should be facilitated and enabled to construct and operate public toilets. Even where the public sector builds the toilets, operation would best be left to the private sector whose interest in profit will ensure sustainability. It also allows the public sector to focus more on regulation and enforcement.

Principle 2: Ring Fencing of Revenues: In the interest of sustainability, it is important that licensing fees (levied by the City or Payams) be treated as a revenue source to be reinvested in expanding sanitation in Juba.

5.1.2 Collection and Transportation of Fecal Waste

The plan proposes the use of the most appropriate and realistic technology. This is particularly important given the current low levels of investment from the public sector and the relatively high investment from the private sector. The lack of a water network, funding, rules and regulations, and institutional capacity eliminates a rapid implementation of the piped sewer network. Transportation of waste through sewer network will be on a measured, incremental basis to allow the City the opportunity to implement institutional requirement for success. Regardless of the implementation of a sewer network, exhauster trucks will remain an important part of waste transportation. Whatever technology is adopted, transportation of waste must meet the minimum requirements of environmental safety and public health protection which do not currently exist.

5.1.3 Treatment of Fecal Waste

The plan proposes the use of the most appropriate and realistic technology for wastewater treatment. Across the continent, there exist very few good examples of successful high tech wastewater treatment Plants. Furthermore, the relatively easy availability of land means that simple technologies such as lagoons can be used effectively.

Principle 1: Develop operation and maintenance activities to maximize the effectiveness and efficiency of the existing treatment facilities.

Principle 2: Construct the planned expansions to the Roton lagoon, to meet demands and maximize use of the site.

Principle 3: Identify other areas to install subsequent treatment facilities.

In the interest of economy, the plan proposes to maximize use of existing facilities prior to construction of new ones. This is also important to ensure that relevant institutions get to grips with what is expected of them in terms of adequate operation and maintenance. Full utilization of existing infrastructure also shows seriousness to potential financiers.

Whatever technology is adopted for treatment of waste, must meet the minimum requirements of environmental safety and public health protection.

5.1.4 Institutional Arrangements

The plan adopts the following key principles.

Principle 1: Principle of decentralization: Service delivery should be managed at the lowest possible level that has the mandate and the capacity to do so.

Principle 2: Best fit for the job: The institutions that take on different roles should be those that have the best fit in terms of technical competency and legal mandate.

Principle 3: Minimal disruption to operations: Any changes to existing institutional arrangements to enable implementation of the plan must be implemented in such a way that there is minimal disruption to service delivery.

Principle 4: Accountability: Changes in institutional arrangements must ensure that there are mechanisms for consumers to hold service providers and government accountable.

Principle 5: Minimal political resistance: Any changes must also take account of the political landscape and preferably choose the paths of least resistance allowing for more difficult changes to take place later.

5.1.5 Financing Arrangements

Principle 1: User pays principle: For financial sustainability, it is key that those who benefit from the services provided under this plan, pay for those services. This will become particularly important as the sewer networks are developed so that the funds can be reinvested to benefit other consumers as well.

Principle 2: Value for money: While the users should pay, it is also important that they get value for their money. This means that there has to be in place systems for tariff setting and regulation that works in favor of both the suppliers and consumers of sanitation services.

Principle 3: Ring fencing of revenues: Sustainability of sanitation services can only be guaranteed if revenues generated in the sector are reinvested back into the sector. This means that there is need to ring fence all revenue streams, particularly those that are being managed by the public sector. Ring fencing is also important as a means of further leveraging financial resources from both donors and the private sector.

5.2 Projections

5.2.1 Population

Most recent official population data for Juba was recorded in the 2008 Census published by the Southern Sudan Centre for Census, Statistics and Evaluation (SSCCSE). The Census lists the population of Juba County at 368,436. The three Payams that comprise Juba City were reported with a population of 230,195 with a breakdown provided in Table 15.

Table 15: Juba Population 2008

Payam	2008 Census Population
Juba Town	82,346
Kator	64,130
Munuki	83,719
Total	230,195

Since 2008 the population of Juba has been impacted by a combination of internal growth, conventional migration and migration of internally displaced persons due to conflicts in the country. As a result the area has experienced significant growth with new informal areas increasing and older informal neighborhoods transitioning into formal areas. A recent mapping and household density study estimates the current (2013) population of Juba at 500,000, which is similar to the number reported by UKAID (2011). These numbers likely include the populations from the neighboring Payams of Northern Bari and Rejaf which are not a part of Juba proper. The City boundary is likely to expand over time to incorporate these payams so a starting population of 500,000 is used as the basis of the projections. From 2008 to

2013 Juba has experienced an average annual population growth rate of 5.71 percent. Given the volatile nature of the forces that govern migration in the region the outlook for future growth is unclear. The Plan continues with the assumption of 5.71 percent growth as a reasonable yet conservative number. It is important to note that the projections are used as a basis for the timing of recommended infrastructure. Should growth occur at a rate that is less than what is projected infrastructure can be deferred. Conversely a higher than expected growth rate would accelerate the need and implementation of infrastructure.

Table 16 presents the estimated population for the 5-year, 10-year, and 15-year Planning horizons. Over the next 15 years the population of Juba is expected to increase approximately 3.3 times.

Table 16: Juba Total Projected Population

Year	Population	Comments
2008	372,413	2008 Census
2013	500,000	Estimate based on mapping
2020 (year 5)	697,693	Based on a 5.71% annual growth rate
2025 (year 10)	920,966	
2030 (year 15)	1,215,688	

5.2.2 Sewerage and Fecal Sludge Generation

Sewerage generation rates for latrine based systems vary greatly. Previous SUWASA documents based on Kenya data cite rates from 0.1 to 0.7 liters per capita per day (l/cap/day) for latrines and 1.7 to 2.6 l/cap/day for septic tanks. Other sources cite 0.164 to 0.220 l/cap/day as reasonable design criteria for latrine and septic systems, respectively. These rates, however, assume significant sludge digestion occurring in the latrine pit over time which for un-lined latrines in Juba may be the case. However, with lined latrines that are routinely pumped there is little opportunity for digestion. In addition it has been reported that lined latrines are open to the soil at the bottom. In areas of high water table, groundwater is entering the pit, increasing the volume of sewerage to be pumped and decreasing the waste residence time in the pit.

Other methodologies link the generation of sewerage as a function of access to water (Table 17).

Table 17: Sewerage Generation Based on Access to Water

Extent of Water Service	Water Demand (l/cap/day)	Sewerage Demand (l/cap/day)
House connection with full plumbing	120	96
Single tap on plot	50	40
Communal water (point per 23 plots)	50	40
Less accessible communal water	30	24

Notes: Sewerage generation based upon 80% of water demand.

Existing data from the survey at the Roton Lagoon provide a basis for a reasonable generation estimate for lined latrines and septic tanks that are regularly serviced by exhauster trucks. Previous studies indicate 82 percent of the population has access to toilets and 40 percent of the toilet facilities are regularly serviced by exhauster trucks and contribute to the sewerage flow at the Roton Lagoon (Table 18).

Table 18: Juba Sewerage and Fecal Sludge Generation Rate Calculation

Parameter	Value
Roton Lagoon Inflow (l/day)	2,309,566
Juba Population	500,000
Ratio of population contributing to Roton Lagoon	0.4
Juba Population contributing to Roton Lagoon	200,000
Sewerage Generation Rate (l/cap/day)	11.55 l/cap/day

The 11.55 l/cap/day value lies between the reviewed latrine generation rate and the water access generation rates and seems to reflect the mix of latrines and pour/flush toilets present in Juba. Projected sewerage rates are developed using a 40 percent coverage (representing the current sanitation coverage of Juba); 55 percent, 70 percent and 85 percent coverage (representing the target coverage for each of the five year Planning Periods- see Table 19).

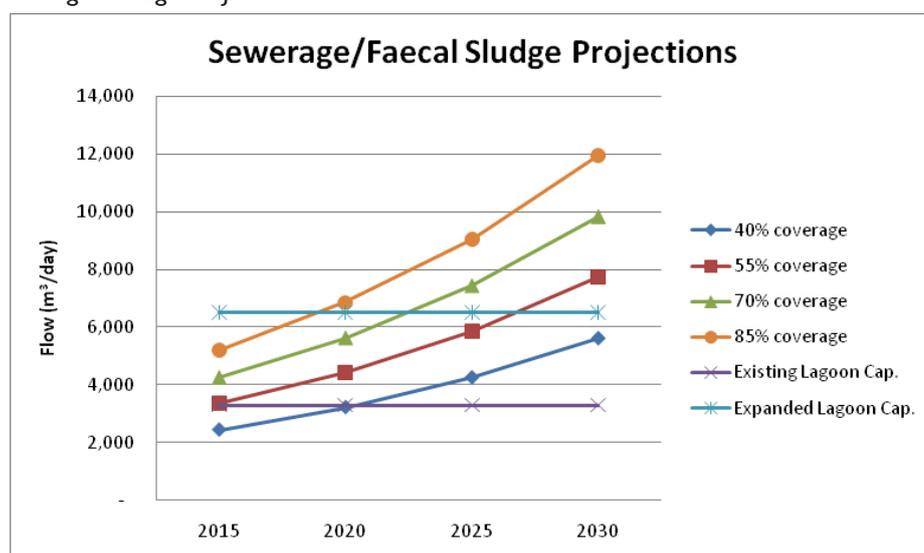
Table 19: Sewerage/Fecal Sludge Projections

Year	40% Coverage		55% Coverage		70% Coverage		85% Coverage	
	Population Served	Fecal Sludge/ Sewerage (m ³ /day)	Population Served	Sewerage (m ³ /day)	Population Served	Sewerage (m ³ /day)	Population Served	Sewerage (m ³ /day)
2015	211,420	2,442	290,702	3,358	369,985	4,273	449,267	5,189
2020	279,077	3,223	383,731	4,432	488,385	5,641	593,039	6,850
2025	368,386	4,255	506,531	5,850	644,676	7,446	782,821	9,042
2030	486,275	5,616	668,628	7,723	850,982	9,829	1,033,335	11,935

Note: All values reported in m³/day. Shaded areas indicate Investment Plan targets as detailed in Section 5.3

Figure 4 below presents the projections in relation to the existing (3,300 m³/day) and expanded (6,500 m³/day) capacity of the Roton Lagoon facility.

Figure 4: Sewerage/ Sludge Projections



As with the population, sewerage rates are projected to more than triple over the next 15 years. The capacity of the existing Roton Lagoon is projected to be reached in 2020 given 40 percent sanitation coverage. However, with increases in sanitation coverage this capacity will be exceeded earlier. The total (existing and future) capacity of the Roton Lagoon will provide treatment for approximately 53 percent of the projected sewerage flows in 2030 at a sanitation coverage rate of 85 percent.

5.3 The Investment Plan

5.3.1 Recommended Technology

The recommended technology in the initial years is a continuation of the basic pour/flush toilet and septic tank technology that is currently employed, with improvements in construction to allow for emptying and transportation of the fecal sludge to the Roton Lagoon. Toilets are assumed to have a pour/flush configuration with a conservancy tank that includes a barrier for the bottom of the pit. The toilets are at both individual household level and also as part of a Communal Ablution Block (CAB) that includes ten pour/flush toilets as well as at least one shower facility. Several case studies in developing countries indicate a range of 5 to 30 households per public toilet. For Juba public toilets, a level of service of one toilet per 8 households is used. Based on an average household occupancy rate of 9.36 persons per household the per capita level of service is 75 persons per toilet or 750 persons per CAB.

Most septic tanks in Juba are not equipped with soakaways (or drainfields) so they are in essence conservancy basins that have to be routinely pumped. This configuration is reported to work well due to the fact that there are areas of high water table and rocky soils that make the successful construction and operation of soakaways difficult. Additionally with the relatively high population density in Juba, the proliferation of soakaways could impact the quality of the local ground water. Although there is potential application for this technology for both public and private toilets, this Plan assumes that septic/conservancy tanks will be primarily present in households with private toilets.

In the later stages of the plan a piped sewerage network is proposed. This technology consists of a standard gravity collection system draining to a pump station that transfers the sewerage to the treatment facilities.

Throughout the 15 year plan consistent promotion of sanitation and hygiene is recommended to support the demand driven approach to sanitation service delivery. This will not only to encourage the use of public toilets but also create a desire for households to have sanitation facilities. Household toilets are expected to play the greatest role in the expansion of sanitation coverage in Juba, with public toilets taking a supporting role to fill the coverage gap. Through aggressive promotion the presence of household toilets are expected to expand by 25 percent for each five year planning period. Table 20 presents the coverage targets for each of the three planning periods as well as individual coverage for private and public toilets.

Table 20: Sanitation Coverage Goals

Planning Period	Total Coverage Goal	Private Toilet Coverage Goal	Public Toilet Coverage Goal
2015-2020	55%	50%	5%
2021-2025	70%	63%	7%
2026-2030	85%	78%	7%

Note: All coverage goals are for the end of the planning period

5.3.2 Five Year Planning Period (2015 to 2020)

Activities in the five year planning period are focused on improving and expanding the existing operational schema of Juba while developing the institutional clarity and capacity to regulate, plan, deliver, monitor, and finance the sector. The plan is driven by increasing the coverage of lined sanitation facilities, currently at 40 percent, to 55 percent over five years. This would include not only the installation of both household and public toilets, but also in some cases replacing existing unlined toilets. The first five year period focuses on the critical needs of the sector – addressing critical health and environmental risks (unlined pits, tanker operation), immediate small scale investment requirements (Lagoon operation and size) and demand generation. This period also focuses on institutional building, improvement of enforcement activities and building the detailed investment plan for the out years.

5.3.2.1 Policy/Regulatory

Exhauster Trucks – The exhauster truck industry in Juba has seen continued success in conveying fecal sludge from users to the Roton Lagoon. However, the trucks represent a potential sanitary hazard as they transport fecal sludge through Juba. Operational standards should be established that detail practices to limit the exposure of the exhauster truck operators and the public to fecal sludge hazards. These standards should include:

- Driver operational standards and required safety gear;
- Storage/ parking of exhauster trucks to minimize contact with the public,
- Truck maintenance requirements.

Private (household) Toilet Facilities – The expansion of private toilets in households will improve sanitation and reduce the amount of toilet sharing that is currently occurring. Existing standards for private toilets should be reevaluated to include consistent and updated technologies for pour flush toilets with conservancy tanks that support the sanitation configuration envisioned in this plan. The standards should include at a minimum facilities that have fully lined conservancy tanks that will isolate wastewater from groundwater. An emphasis should also be placed on the rigorous implementation and enforcement of building codes with respect to sanitation requirements. Continued sanitation and hygiene promotion is included to increase interest and investment in private toilet facilities.

Public Toilets – As with private toilets, existing standards and specifications for public toilets should be updated and streamlined to consistently require the construction of fully pour/flush type toilets with conservancy tanks that can be effectively pumped by exhauster trucks. Public toilet standards may also be drafted to include the presence of showers or laundry facilities. In addition development standards should be put in place that set the level of service of toilets (persons per toilet) in public areas and in informal residential areas. Typical values for public toilets range from 5 to 30 households per toilet. For purposes of this plan a level of service of eight households per toilet is selected as it is on the lower end of the typical range for such facilities.

The proper locations and distribution of public toilets through Juba is crucial to providing adequate coverage for the population. The city should adopt development and planning requirements that provide for toilets in a spatial relationship that would provide the best access to the population. Typically this is accomplished by developing a maximum allowable distance from households, for example 50m, which would define the spacing of public facilities.

In addition to physical standards for public toilets, operational standards that delineate levels of cleanliness, security and privacy requirements should be implemented.

Roton Lagoon – Although the lagoon is providing some measure of treatment, it is not meeting World Bank effluent quality standards. Developing and implementing national effluent quality standards will provide a benchmark with which to measure the lagoon’s performance and will ultimately serve as a basis for regulation.

5.3.2.2 Physical Facilities

The physical facilities for the Five Year Plan include increased coverage of public and private toilets in Juba (Annex 2) and the accompanying exhauster trucks to transport the fecal sludge to the Roton Lagoon. The Plan also envisions expanding the existing Roton Lagoon site to its full capacity to meet the increased sewerage load.

Private (household) Toilet Facilities - Coverage of private (household) toilets is expected to increase both organically with the development of larger, permanent households in Juba as well as with a deliberate sanitation marketing campaign. A 25 percent increase in private toilet coverage is expected by the end of the planning period raising the coverage percentage from 40 percent to 50 percent. This will require the installation of 14,682 toilets in households at an estimated cost of US\$14.7 million.

Public Toilets - Coverage of public toilets in the informal areas is expected to occur as an on-going program to expand sanitation facilities in the informal areas. The goal for the first five years is to expand coverage to serve 5% of the population. This will require installing additional facilities to accommodate not only growth but also to expand coverage of the population as it currently exists. This will require installing 47 CABs at a total capital cost of US\$2.8 million.

With private and public toilet coverage combined, sanitation coverage in Juba will increase to 55% by 2020. Achieving this goal will generate an additional 1,990 m³/day of sewerage for a total of 4,432 m³/day.

Exhauster Trucks – The exhauster truck sector is expected to grow to meet the needs of the expanded wastewater coverage. At current levels of operation an additional 48 trucks would be required at an average volume of 18,000 liters by the end of the Planning period. The estimated cost of the trucks is US\$4.0 million.

Roton Lagoon – A primary concern of the lagoon system is its current operational state. In the near term additional studies should be conducted to determine the level of grit buildup in the anaerobic basin, identify potential causes for the red effluent, and develop possible strategies to reduce short circuiting in the basin. An initial amount of US\$200,000 is budgeted for the study.

The addition of toilets in the first five years will increase the current flow at the Roton Lagoon by 1,990 m³/day of sewerage. An expansion of the facility to its full on-site capacity of 6,500 m³/day is required. In addition to the expansion of treatment capacity, the access road to the facility will be upgraded to a paved road to better handle the increased exhauster truck traffic. Total capital costs for these facilities is estimated at US\$3.8 million .

Small Lagoon Facilities – The two small lagoon facilities require immediate action to minimize access by the public and eliminate off-site discharges that represent a sanitary hazard. The first phase of the small lagoon management Plan is to maintain and upgrade the existing facilities and provide for facilities for the exhauster trucks to routinely remove effluent from the ponds to the Roton Lagoon for additional treatment. Complete elimination of the lagoons will occur in the ten year planning period.

Activities include dredging the existing lagoons to remove accumulated debris, increase treatment efficiency, erect barriers to limit public access, and develop an effluent receiving structure. The effluent receiving structure will serve as the location to move effluent off site. In the short term the structure will

serve as a location for exhauster trucks to remove effluent for further treatment at the Roton Lagoon. These are estimated at US\$550,000.

Second Lagoon System – In preparation of the growth occurring in the second planning period securing land for a lagoon facility to support Roton is scheduled. The new facility may be located adjacent to the existing Roton facility or some other area depending on development patterns and availability of land. A total of US\$400,000 is budgeted for a land purchase for a new lagoon treatment facility.

5.3.3 Ten Year Planning Period (2021 to 2025)

The Ten Year Planning Period continues increasing the coverage of latrines in Juba, a further expansion of the lagoon treatment facility and a demonstration test of the piped sewerage network in Juba. The introduction of a piped sewerage network in Juba represents a significant shift in the sewerage operational schema in Juba and requires significant progress in developing the rules, regulations, and institutional capacity for successful operation. Exhauster trucks will continue to be the primary form of waste collection with the piped network serving a limited area to test its effectiveness. Whilst other intermediate options such as condominal sewer systems have been considered, they are however not recommended for Juba mainly because of the need for greater institutional and social mobilization compared to conventional sewers. For Juba with its limited institutional capacity, it will be easier to introduce a conventional sewer and later consider more complicated options including condominal sewers.

5.3.3.1 Policy/Regulatory

Policy and regulatory concern for the Ten Year Planning Period focus on defining and implementing the requirements to support a piped sewerage network in Juba. This would entail a logical expansion of building standards developed in the previous planning period to include pipes and pump stations, and development of operational guidelines and suitable training to successfully operate and manage a piped network.

Piped Sewerage Network Cost Recovery– Recovery of costs for the piped sewerage network will likely take the form of a monthly user rate. Although the exact mechanism will be determined during the planning period a set of rules defining how rates are established, developed and monitored are required.

In addition a set of standards for the piped sewerage network are required to guide the design and operation of the facilities.

5.3.3.2 Physical Facilities

Private/Public Toilets – Sanitation coverage is expected to increase to 70 percent by the end of this planning period. As with the five year planning period this is measured by the increased presence of household toilets and CABs. Household toilets will provide 63 percent sanitation coverage at the end of the planning period with an additional 24,226 toilets estimated at US\$24.2 million. A total of 92 CABs are required to provide an additional 7 percent coverage at a total cost of US\$5.5 million.

Exhauster Trucks – The exhauster truck sector is expected to grow to meet the needs of the expanded wastewater coverage. At current levels of operation an additional 73 trucks would be required at an average volume of 18,000 liters by the end of the planning period. The estimated cost of the trucks is US\$6.1 million .

Sewerage network – A limited piped sewerage network is proposed to act as a test case for a wider scale implementation in the following planning period. Identification of the area served by the network is contingent upon a number of factors.

1. Parallel Water Network – The presence of a water network is essential to providing sufficient volume to allow the sewerage collection system to operate successfully.
2. Housing Density – A high density of housing units is preferred to minimize the cost of the infrastructure per household. Piped networks benefit from economies of scale where the costs can be shared among many households.
3. Development Pattern – In proposing the installation of the piped infrastructure, the plan considers the five types of settlements described in Chapter 2. Installation of piped infrastructure in Juba is will be easier and less expensive in the Transitioned Formal Areas particularly Munuki and Gudele One. As described in Chapter 2, Transitioned formal areas are neighborhoods that were informal but were formalized through a planning process in 2008/9. These areas have road reserves that are not paved and would therefore make installation of below ground piping much less expensive. Secondly, they tend to house the socially upward middle income groups for whom a connection to a sewer network could be an aspiration for which they would be willing to pay. Thirdly, they are located close to the Roton lagoon which would reduce the cost of investment, as only limited pumping would be required. Finally, these areas are earmarked for development of a piped water network by the SSUWC which is critical to installation of the proposed sewer network. To be truly functional the sewerage network would therefore be designed along with the water network and installed concurrently along roadways. It should be noted that even though there are new formal areas that were planned in 2007 and settled in 2012, they are not proposed for the pilot sewer network for the reason that these areas are still largely vacant and would therefore have a limited population and raise the per capita cost of the project. Similarly informal areas are not considered because of their unplanned nature and related challenges of accessing land. On the other hand, the formally established areas are not proposed because of the existing paved roads which would raise the investment costs and also because of their location too far from the Roton lagoon.
4. Topography/Location of Treatment facilities – If possible the system should be located in an area with a consistent sloping topography to minimize pumping and located near the treatment facilities to minimize the cost of piping.

Previous studies identified areas in northern Munuki as a likely candidate for the installation of a water supply network. In addition to the advantage of having a proposed water network, this area also benefits a sewerage system by being a rapidly transitioning area, and having an elevation higher than that of the Roton Lagoon. Another potential location is the area of Tong Ping adjacent to the piping facilities that will be installed to eliminate the small lagoon system (see below). The proposed project would serve approximately 250 homes (2,300 people). The presence of a water supply system and therefore increase usage in houses will increase the sewerage generation rate from the 11.55 l/cap/day to an estimated 20 l/cap/day for a total sewerage contribution of 46,000 l/day. The installation of the network would count toward the 70 percent coverage goals for the five year plan.

The system will consist of service connections that connect the latrines or conservancy tanks to the collection system. The collection system will transfer the sewerage by gravity to a pump station that will pump the sewerage to the Roton Lagoon. Given the location of the Roton Lagoon an extensive force main and pump station system will be required. This infrastructure will also serve to act as a transmission system for future piped network expansions in Munuki and Northern Bari. The estimated quantities for the system are shown in Table 21. Total costs are estimated at US\$2.1 million .

Table 21: Ten Year Planning Period Piped Sewerage Network

Component	Quantity
Collection Line 200mm PVC	2,500 m
Manholes, precast concrete	25 each
Pump Station, precast concrete 2m diameter; 5 m deep; two pumps	1 each
Force Main to Roton Lagoon, 200mm PVC	6,000 m

Roton Lagoon – At the end of the ten year planning period flows received by the Roton Lagoon are projected to increase to 7,446m³/day. An additional 3,200m³/day capacity expansion is planned in this planning period to meet the flow requirements. Unlike the expansion in the five year planning period, this expansion will be built upon the new land that was previously purchased. It is assumed that the new lagoon will be located adjacent to or near the existing Roton Lagoon; however growth patterns may dictate a more advantageous location. A total amount of US\$2.8 million is estimated for the expanded treatment capacity.

Tong Ping Lagoon – The ten year plan includes the elimination of the small lagoon system in Tong Ping with the installation of a receiving pump station and force main to directly transfer the wastewater to the Roton Lagoon. Much of the transmission system to Roton will be constructed as part of the piped sewerage network mentioned above. The total costs are estimated at US\$500,000.

5.3.4 Fifteen Year Planning Period (2025 to 2030)

The fifteen year planning period completes the coverage of the Juba with public and private toilets, expands again the lagoon system and extends the piped sewerage network.

5.3.4.1 Policy/Regulatory

By the fifteen year planning period the basic policy and regulatory framework is expected to be set and further changes will be refinements and modifications of the system already in place.

5.3.4.2 Physical Facilities

Private/Public Toilets – Sanitation coverage is expected to increase to 85 percent by the end of this planning period with 78 percent provided by household toilets and 7 percent provided by CABs. A total of 39,974 household toilets are required at a total cost of US\$40million. The 112 CABs required to meet the coverage goal are estimated at US\$6.6 million.

Exhauster Trucks – The exhauster truck sector is expected to grow to meet the needs of the expanded wastewater coverage. At current levels of operation an additional 83 trucks would be required at an average volume of 18,000 liters by the end of the planning period. The estimated cost of the trucks is US\$6.9 million .

Sewerage Network – Provided the demonstration piped sewerage network from the ten year planning period is successful, the sewerage network will be expanded to encompass another 750 homes and adding pumps to transfer the sewerage directly to the Roton Lagoon. The estimated quantities for the system are shown in Table 22. The sewer network is estimated at US\$1.4 million.

Table 22: Fifteen Year Planning Period Piped Sewerage Network

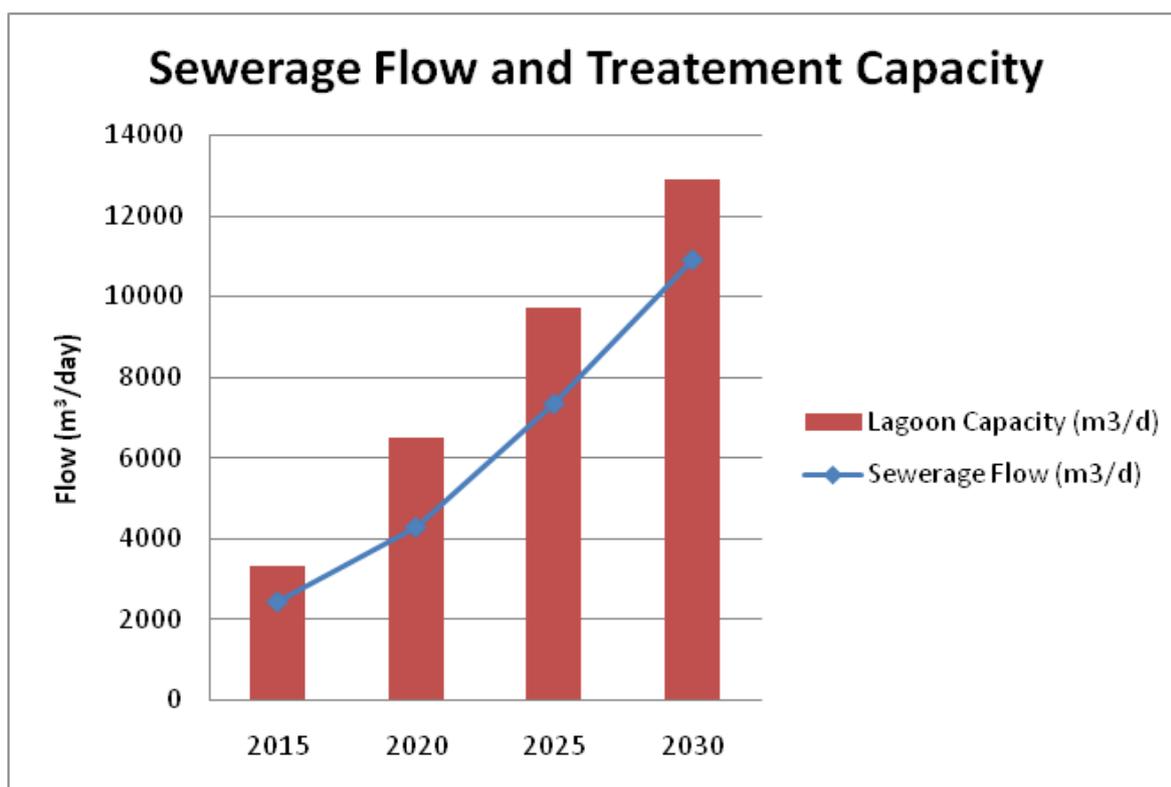
Component	Quantity
Collection Line 200 mm PVC	6,000 m
Manholes, precast concrete	75 each
Pump Station, precast concrete 2m diameter; 5 m deep	1 each

Roton Lagoon – At the end of the fifteen year planning period flows collected for treatment are projected to increase to 10,700 m³/day. In keeping with the modular units used with previous expansions a 3,200 m³/day capacity expansion is planned in this planning period to meet the flow requirements. If an additional location for treatment was not selected in the 10 year planning period an alternate location, likely to the west is recommended to reduce the travel time of exhauster trucks. A total amount of US\$3.6 million is estimated for the expanded treatment capacity.

5.4 Summary of Investment Plan

The Investment Plan seeks to achieve at least 85 percent sanitation coverage with treatment by the year 2030. Figure 5 below shows the projected sewerage flows and lagoon treatment capacity for the fifteen year period. The sewerage flows represented increase as a function of not only growth within Juba but also as sanitation coverage city wide is expanded.

Figure 5: Sewerage Flow and Treatment Capacity



5.4.1 Investment Plan Capital Costs

A summary of the facilities and capital costs required is provided in Table 23 below while Annex 3 shows the calculations that form the basis of these costs.

Table 23: Summary of Investment Plan Capital Costs (in 2014 USD)

Component	Five Year		Ten Year		Fifteen Year	
	Quantity	Cost	Quantity	Cost	Quantity	Costs
Household Toilets	14,682	\$14.7 million	24,226	\$24.2 million	39,974	\$40.0 million
Communal Ablution Blocks	47	\$2.8 million	92	\$5.5 million	112	\$ 6.7 million
Exhauster Trucks	48	\$4.0 million	73	\$6.1 million	83	\$6.9 million
Treatment Capacity	3,200 m ³ /day	\$4.4 million	3,200 m ³ /day	\$2.8 million	3,200 m ³ /day	\$3.6 million
Sewer Network	None	None	See Table 1	\$2.1 million	See Table 2	\$ 1.4 million
Small Lagoons	See Text	\$0.6 million	Decommission Tong Ping	\$0.4 million		
Total		\$26.1 million		\$41.2million		\$58.6million

5.4.2 Software Costs

As the plan is also about reform, provision is made for software elements as well. On the assumption that the startup of these activities will be slow in the first five years, the plan provides for 10% of capital costs as required investment for software elements for the five year planning period. The proportion is raised to 15% in the 10 and 15 year planning periods in anticipation that momentum would have been built on these elements by that time. The software elements budgeted for include the following:

1. Development and implementation of Sanitation marketing campaigns to promote household construction of toilets;
2. Development and implementation of hygiene promotion program;
3. Technical assistance for institutional restructuring in the subsector;
4. Technical assistance for development of policy and legal frameworks;
5. Capacity building of relevant sector institutions;
6. Technical assistance for development of standards and procedures for design and construction in the subsector.

Capital and software investment in the sanitation system in Juba is estimated at US\$207.14million in 2014 USD as detailed in Table 24 below.

Table 24: Summary of Investment Plan Capital and Software Costs (in 2014 USD)

Component	Five-year	Ten Year	Fifteen Year	Total
	Cost	Cost	Costs	
Household Latrines	\$14.7million	\$24.2 million	\$39 million	\$77.9 million
Communal Ablution Blocks	\$4.1 million	\$6.3 million	\$ 9.3 million	\$19.7 million
Exhauster Trucks	\$4.0 million	\$6.1 million	\$6.9 million	\$17 million
Treatment Capacity	\$4.4 million	\$2.8 million	\$3.6 million	\$10.8 million
Sewer Network	None	\$2.1 million	\$ 1.4 million	\$3.5 million
Small Lagoons	\$0.6 million	\$0.4 million	None	\$1 million
Total	\$13.1 million	\$17.7 million	\$21.2 million	\$52 million
Grand Total (Hardware)	\$40.9 million	\$59.6 million	\$81.4 million	\$181.9 million
Software	\$4.09 million	\$8.94 million	\$12.21 million	\$25.24 million
Grand Total	\$44.99 million	\$68.54 million	\$93.61	\$207.14 million

6.0 Financing

6.1 Introduction

As the sanitation sector in Juba expands to meet the needs of the population, significant funds are required to create a sustainable fecal sludge and sewerage system. The overarching financial goal is to create a system that has the ability to construct, operate and maintain itself from funds generated by the system. This section looks at some fundamental principles required to support increased financing to the sector from the different players, including current fund flows, possible funding sources, and then proposes financing arrangements for the Investment Plan.

Current donor programs increasingly stress the importance of community-led and -owned programs, modern marketing techniques, and household choice in selection of a toilet. The current structure of sanitation services in Juba is a relatively decentralized, consumer demand driven model that combines private and public participation. Based on the recent successes reported by donor agencies working in other cities, it is recommended that Juba's structure, which is working for a small segment of the population, be investigated and enhanced to increase coverage to a greater percentage of the population.

More specifically, this plan considers building upon the current decentralized model: utilizing private sector incentives, with some oversight, to install and maintain residential and commercial sanitation facilities (e.g. communal ablution stations and exhauster trucks) and to manage and expand the Roton Lagoon. Public sector participation includes lagoon management, regulatory oversight, and educational programs. In addition, a combination of donor and public sector participation and funding is recommended in the early stages to develop programs and training, with donor content being transferred to the local community, public sector oversight, and private sector management as soon as is appropriate.

6.2 Flow of Funds

The Juba sanitation sector is currently supported by a combination of user rates and donor funding. This arrangement has evolved in the private sector with minimal government involvement. While this framework is not sustainable for the long term, there is apparently a sufficient level of funding at present to keep the system functioning as government institutions move toward playing a more active role in sanitation.

User rates are charged by the vendors of public toilets for use of the facilities and by exhauster trucks for the collection and transportation of fecal waste. As demonstrated in Sections 3.3 and 3.4 in the Problem Statement, both the public toilet and exhauster truck segments of the system are operating profitably. However, the level of service of these segments is inconsistent and required improvements will increase costs.

6.2.1 Public Toilets

Public toilets have developed a user pays system that covers the costs of operation. The proliferation of public toilets in Juba without donor assistance indicates that a not insignificant number of users are willing and able to pay for sanitation services at levels that provide sufficient cost recovery to encourage reinvestment in capital assets.

Costs can be divided into two categories: 1) operations and maintenance and 2) capital. Toilets and community ablution stations are relatively inexpensive to build and therefore present a low investment threshold for facility expansion. Properly constructed toilet facilities as described in Section 5.3 are marginally more expensive to construct but potentially less costly to operate and maintain. Financing arrangements should be structured to encourage facilities that have a greater likelihood of long term success, that is, sufficient funding for construction so that toilet facilities meet the desires of users, are easy and inexpensive to operate and provide improved levels of sanitation.

Donor funding is generally based on an assumption of improved sanitation. However, successful solutions will need to take into account many other factors; improved sanitation must be the outcome but is not the only consideration. To ensure long-term sustainability of the approach, as well as to increase the population served, users' demand preferences must be considered.

It has been shown that health and sanitation may not be the primary driver of perceived need. Instead, users may value safety, convenience, privacy, or quality of construction above health and sanitation. It is important that the demand preferences unique to Juba be understood and considered as a key factor in structuring financing.

For instance, users' preference for quality construction might include a brick superstructure to ensure privacy and impart an image of quality, as well as deeper pit construction to reduce servicing costs (frequency of emptying). Unfortunately, it has been shown that where pit latrine construction costs were limited to available (and insufficient) subsidy amounts, many constructed pit latrines were unsustainable. The non-existent superstructures didn't meet users' needs for privacy and safety, operating costs were too high for users due to shallow pits that required more frequent servicing, and some latrines experienced outright operating failures due to the poor construction.

User preferences are important and unique to the locale. The ultimate solution for Juba, including the financing options, needs to be structured to consider local demand and supply drivers. Sufficiently researched, these drivers should account for local conditions and ability to pay, while greatly improving the likelihood that the final solutions set(s) will address user preferences, improve sanitation and provide long term viability.

6.2.2 Exhauster Trucks

As with public toilets the exhauster truck segment has developed a system of user rates paid by owners of public toilets, businesses and households to transport fecal sludge. For privately owned trucks the current system of charges appears to support the segment for both O&M costs, registration and license fees to local government and capital investment. The few publicly owned trucks in Juba are not actively maintained and require external support from donors to retain functionality.

At SSP446 (US\$144), the average cost of emptying a pit latrine seems high. The cost of SSP446 may or may not be reasonable. As mentioned earlier, further investigation of what the average family can afford, broken down into different income categories, would be helpful in financial structuring.

If it is found that profit rates are unreasonably high, increased competition and government oversight could help reduce servicing costs and support greater sanitation coverage of the population. Providing micro financing for truck purchases could also help improve competition.

It should be noted that costs could be high due to perceived or real risks to drivers of exhauster trucks. These risks could be related to security, cultural, sanitation, crime or other issues. Any such issues need to be researched and described in detail.

6.2.3 Roton Lagoon

The Roton Lagoon is operated by Juba County. A fee is charged to exhauster trucks to off-load fecal sludge at the site, but it is unclear how these funds are used to cover the expenses of operating the lagoon. Recent inspections at the lagoon indicate that additional maintenance is required to keep the facility operating properly. Unlike public toilets and exhauster trucks, sewerage treatment facilities require significant capital investment and often require third party financing as a precondition to construction. A system of ring fencing generated finances is also necessary for adequate operation and maintenance.

The charge for dumping at the lagoon (lagoon revenue) should be set so that it is sufficient to cover all operating costs—labor, equipment, maintenance, and depreciation. It should also include costs to regulate the exhauster trucks and perhaps a small amount to cover other related costs, such as education. A key provision of the Investment Plan is to expand the lagoon. The cost for expansion may be added to the current usage fee but if this increases costs to an unaffordable level, other means of financing should be explored, such as a combination of loans, donor funding, and other cost sharing methods. It is important to balance the cost of dumping at the lagoon with the ultimate charge to users, as increasing costs to users will price a percent of the population out of the ability to afford toilets.

While it is possible that at a later date subsidies may be available for the poorest percent of the population, it is better to keep the pricing structures simple. Providing subsidies for the lagoon expansion is a much less complex transaction than trying to subsidize maintenance fees for thousands of families for months or even years. Reducing operations and maintenance fees that are passed onto households should be a priority as it allows more households to immediately afford sanitation.

6.3 Managing Competitive Forces in the Private Sector

While the profit motive associated with the private sector is widely regarded as a driver for the most cost-effective provision of goods and services, this is only true in an open market with a sufficient number of competitors and some level of government oversight. Otherwise, the profit motive can drive the private sector towards monopolistic practices that increase costs for buyers. A monopoly exists where a supplier has control over pricing and may therefore charge very high rates and earn unreasonably high profit margins, and buyers are mostly powerless to effect changes in price. Water and wastewater utilities with extensive distribution and collections systems and expensive treatment plants are often cited as natural monopolies. Their high infrastructure costs create barriers to entry for competitors. Government oversight is required to ensure that user rates are kept in an affordable range.

The Investment Plan provides estimates of monthly operating costs for sanitation in Juba. Costs are shown in both the South Sudanese Pound (SSP) and US dollar. When converted to US dollars, the costs appear high relative to other countries. However, published exchange rates for the SSP vary considerably; recently the government devalued the SSP to bring official conversion rates more in alignment with black market rates. Even at the devalued level, though, the US dollar costs shown in the Investment Plan are very high, raising concern that monopolistic practices exist within the private sector.

One way to discourage monopolistic practices is to ensure sufficient competition. If current suppliers are making unreasonably high profits, other potential suppliers will be induced to enter the market. Reducing barriers to entry will aid in this process. As more competition is introduced with sufficient government oversight to prevent cartel behavior, strong downward pressure on prices will occur. In order to attract financing to the city, sanitation must be affordable, so this question needs to be addressed and resolved. In the long term rate regulation through a properly authorized government institution will provide this service.

6.4 Capital Costs and Financing

While the cost of construction for many of the components of the system may be low relative to alternative sanitation approaches, recovery of the costs will likely exceed many people's ability to pay. A large percent of the populace cannot afford the large up-front construction costs but can afford maintenance costs, debt service, and perhaps a small portion of the construction costs. As a result, a viable approach may be to provide third party financing mechanism for construction, in the form of donor grants, low-interest loans, or a combination of both.

Financing of sanitation facilities tends to be viewed as highly risky by traditional lenders. Development and utilization of one or more micro-finance facilities that are focused solely on sanitation could help alleviate this problem.

There are many ways to structure debt funding. In most cases, it is recommended that the users pay at least a portion of the construction cost as this demonstrates a willingness and commitment to pay the maintenance fees. The remainder of the construction funding could come from a combination of donor funding and micro finance.

Alternatively, some communal ablution stations are likely owned by third parties who would charge for usage. Usage charges (e.g. a monthly lease) would cover maintenance, depreciation, and financing fees. If a portion of the cost was covered by donor agencies, the depreciation element of the usage charge would need to be reduced.

Different programs may need to be made available to users based on ability to pay. Additional information on the population's ability to pay would be helpful. Early programs tend to focus on the households that can already afford toilets, but do not have them because of a lack of institutional support. As more and more toilets are installed, the programs evolve and learn so that greater and greater percentages of the population receive sanitation.

6.5 Funding Sources

6.5.1 Government

Subsidization of capital costs through government contribution is a common means of infrastructure development for developing countries. As a utility system works toward 100 percent sustainability an intermediate step is to develop a set of user rates and revenue recovery procedures that recover only operations and maintenance costs, while relying upon government funds for capital projects. Once 100 percent O&M cost recovery is achieved rates can be gradually increased to reduce the role of government in capital funding. Government funding is considered favorably by private and donor sources as an indication of a commitment to infrastructure investment. Frequently a certain level of government funding participation is a prerequisite to receiving donor funds.

6.5.2 Private Sector Investment

Private sector participation at the ownership level has proven to be successful in providing sanitation service for public toilets and exhauster trucks, and it is likely to continue to play a large role in the expansion of sanitation coverage in the future. However, for more capital intensive portions of the Investment Plan, including sewerage treatment and piping networks, third party funding will be necessary, until the sanitation sector achieves complete cost recovery.

Funding from the third party private sector can include loans from commercial investors that are repaid over time with interest. The key to attracting funding is to provide a rate of return for the investor that

is commensurate with the risk involved. It is worth noting that in Juba, borrowing from the commercial banks has not been widely reported by the exhauster businesses. The main financing has been from own resources and this is likely to remain the case for some time.

The following factors are important to securing private investment:

- A stable government institutional framework that supports and fosters the sanitation sector, with a focused purpose and clearly defined mission;
- Institutional capacity to own, plan, manage and operate the sanitation system. This may also be accomplished through government outsourcing in a private-public partnership;
- A realistic business plan and investment plan that includes long terms goals and objectives for a sustainable system;
- Sustainable operations including transparent cash management that demonstrate the system is an on-going enterprise;
- Government participation in the funding of capital projects.

For the private sector these factors are important in determining if the system is capable of generating sufficient revenues to repay the debt plus a rate of return.

6.5.3 Donors

Unlike the private sector, donor funding does not demand a rate of return. However depending upon the donor agency meeting a number of performance benchmarks regarding the sustainable operations of the system may be required. Donor funding relies upon many of the same factors listed for private investment except the donor agencies can also play a role in institutional capacity building and system planning.

Recent donor contributions include large capital projects such as the Roton Lagoon and several smaller public toilets throughout Juba. Donors are also more likely to intervene in the interest of securing public and environmental health.

6.5.4 Public Private Partnership (PPP)

The advantages of private participation are already evident in Juba, in particular the fact that private enterprise can provide technical, financial and logistical resources that government cannot. While this is currently the case for public toilets and exhauster trucks, private enterprise may also play a role in the operations and planning of the sewerage treatment segment. There are varying degrees of PPP's depending on the level of involvement of the respective parties. A "private heavy" arrangement has the private entity taking on full engineering, operations and management functions while the public partner focuses primarily on the monitoring and evaluation of the contract. In a "public heavy" partnership the private entity may be contracted for a very limited scope of service like billing and collection, or sewerage treatment plant operations, while the government assumes the bulk of the responsibilities.

To attract heavy investment in a centralized wastewater utility build out, there are a number of different options. One option is to find a large, private, utility-based company to take over the sector; build out the infrastructure, establish the connections and collections from users, maintain and operate the system, and finance the work internally or through a special purpose entity. The company would typically fund this through its internal corporate finance function, utilizing corporate bonds, secured loans, stock offerings, etc. The company raises this funding based on the strength of its other income and balance sheet and on the reasonableness of the new investment. This type of funding is appealing to lenders because of

a heightened certainty of repayment; however, the reality is that Juba is not likely to attract this type of company at this early stage in its development because the risks associated with the investment are too high.

Alternatively, a company may take on a smaller portion of the build out and finance that on its balance sheet. This is a more likely scenario for Juba. Providing incentives for small, local entrepreneurs is more likely to meet with success.

For extremely large, new infrastructure investments that an existing company cannot finance based on its existing balance sheet, an alternative method that has been found useful for single-purpose efforts is called “project financing.” Project financing is a means of structuring private funding of large-scale infrastructure projects. In developing countries, these projects must be supported by political risk insurance from multi-lateral agencies such as World Bank.

While Juba is not ready for a large project financing, it may work toward this in the next ten years. In addition, developing a wastewater utility with ring-fenced finances and accounting systems that track and control revenues and costs; increasing the percent of the population that has access to sanitation; and building the regulatory function are important steps that will provide immediate and long-term benefits. It should be noted that while World Bank is not providing political risk insurance for large private investments in South Sudan; it is providing donor support.

6.6 Financing Arrangements

6.6.1 Financing Arrangements 2015 to 2020

- For the household toilets, it is proposed that homeowners finance onsite capital and maintenance costs. However if it is in public health interest, government could provide subsidies to deserving segments of the population.
- The private sector should also continue capital expansion in both public toilet facilities as well as exhauster tanker business to meet coverage goals. The city council and donors can however also provide capital funding to further the expansion of public toilets, with operations handled by either the local authority or outsourced to private vendors. The plan proposes a continued reliance upon public toilet vendors and exhauster truck companies to set user rates but with a heightened regulatory oversight by the public sector to both protect consumers and ensure compliance.
- Local government with the assistance of multi-lateral donors should develop the following programs and policies to facilitate the expansion of sanitation.
 - Streamline and formalize registration, license fees and tolls paid by exhauster trucks;
 - Conduct an affordability study of sanitation services in Juba;
 - Support increased competition among exhauster truck companies to help reduce end-user rates
 - Develop framework for micro-finance lending.
- The actors should secure and assure the revenue stream from the exhauster tankers by quickly streamlining and formalizing registration, license fees and tolls paid by exhauster trucks.
- Funding of Roton Lagoon expansion should be from a mix of government and donor sources particularly taking into account the existing revenue stream from the tankers.

6.6.2. Financing Arrangements 2021 to 2025

- Continued reliance upon the competitive marketplace to set user rates for public toilet vendors and exhauster truck companies and upon vendors and truck companies to set user rates and continue capital expansion in their respective segments to meet coverage goals.
- Local government, donors and the private sector to further the expansion of public toilets.
- Funding of Roton Lagoon expansion from a mix of government and donor sources
- Ring fence piped sewerage network and develop cost of service based user rates.
- Solicit donor and private investment for the pipe sewerage network.
- Begin rate regulation (if institutional capacity exists) for public toilets, exhauster trucks and piped sewerage network.

6.6.3 Financing Arrangements 2026 to 2030

- Continued reliance upon public toilet vendors and exhauster truck companies to set user rates and continue capital expansion in their respective segments to meet coverage goals.
- Local government and donors to further the expansion of public toilets. Operations may be by government or outsourced to private vendors.
- Funding of sewerage treatment expansion from a mix of government and donor sources
- Ring fence piped sewerage network and develop cost of service based user rates.
- Solicit donor and private investment for the pipe sewerage network.

Tables 25 and 26 show proposed financing arrangements for the Investment Plan.

Table 25: Proposed Financing Arrangements

Activity	Financier		
	2015-2020	2021-2025	2026-2030
Containment of fecal Sludge			
Household Toilets	Homeowners	Homeowners	Homeowners
Public Toilets	Private Sector mainly but also Public sector	Private Sector mainly but also Public sector	Private Sector mainly but also Public sector
Transportation of Fecal Sludge			
Exhauster Tankers	Private Business	Private Business	Private Business
Sewerage Network	N/A	Public Sector and home-owners	Public Sector and home-owners
Treatment of Fecal Sludge/ sewerage			
Roton Wastewater Treatment Plant	Public Sector (Juba City Council) and possible private sector	Public Sector (Water Utility)	Public Sector (Water Utility)
Hai Amarat and Kololo Lagoons	Public Sector (Juba City Council)	Public Sector (Water Utility)	N/A

Table 26: Sources of Financing

	Private Toilets		Public Toilets		Exhauster Trucks		Piped Collection Network		Treatment	
	O&M Costs	Capital Funding	O&M Costs	Capital Funding	O&M Costs	Capital Funding	O&M Costs	Capital Funding	O&M Costs	Capital Funding
Government Ownership	NA	NA	Rates charged to users	<ul style="list-style-type: none"> • Cash funding from rates (low investment threshold) • Cash funding from taxes and other fees • Debt secured by user rates 	Rates Charged to owners of pit latrines and conservancy tanks.	<ul style="list-style-type: none"> • Cash funding from rates (low investment threshold) • Cash funding from taxes and other fees • Debt secured by user rates 	Rates charged to customers receiving service from the network.	<ul style="list-style-type: none"> • Debt secured by user rates (requires fencing) • Donor funds 	<ul style="list-style-type: none"> • Rates charged to exhauster trucks for disposal • Rates charged to custom-ers on the piped network 	<ul style="list-style-type: none"> • Debt secured by user rates (requires fencing) • Donor funds
Private Ownership	By home owner	By home owner. Possible government subsidization.	Rates charged to users	<ul style="list-style-type: none"> • Cash funding from rates (low investment threshold) • Cash funding from taxes and other fees • Debt secured by user rates 	Rates Charged to owners of pit latrines and conservancy tanks.	<ul style="list-style-type: none"> • Cash funding from rates (low investment threshold) • Cash funding from taxes and other fees • Debt secured by user rates 	Rates charged to customers receiving service from the network.	<ul style="list-style-type: none"> • Given the magnitude of the investment private ownership would require debt and equity investment from a utility company 	<ul style="list-style-type: none"> • Rates charged to exhauster trucks for disposal • Rates charged to custom-ers on the piped network 	<ul style="list-style-type: none"> • Given the magnitude of the investment private ownership would require debt and equity investment from a utility company

7.0 Institutional Arrangements

7.1 Introduction

To achieve the intended goals of this Investment Plan, it will be necessary to strengthen institutional arrangements in the sector. This section outlines proposed institutional arrangements that should be improved progressively along the same 5, 10, 15 year planning horizons. The institutional arrangements are organized around the three key fecal sludge management pillars of containment, transportation and treatment of fecal sludge. Relevant policy and regulatory aspects for each phase and pillar are also discussed. In proposing the institutional arrangements, the plan adopts the following strategic principles:

- Locate activities along the fecal sludge management chain with institutions that are best placed to undertake those activities for enhanced efficiency and effectiveness in service delivery;
- Minimize disruption to current operations;
- Minimize and take account of political-economy related issues that would make it difficult to achieve desired results. Institutional change always entails changing power relationships and is therefore often resisted by those who perceive themselves as potential losers. In order to ensure that necessary changes do occur, it is therefore important to have a clear understanding of all the groups of potential winners and losers and to put in place mechanisms to deal with the concerns and wherever possible minimise losses or avoid or compensate would be losers;
- To the largest extent possible maximize use of the private sector;
- Promote enhanced collaboration amongst the different institutions involved;
- Take account of the political climate in the country with associated difficulties in carrying out reform activities.

7.2 Institutional Arrangements 2015-2020

7.2.1 Containment of Fecal Sludge:

7.2.1.1 Household Toilets and Public Toilets:

It is proposed that the overall responsibility for this component should rest with the Juba City Council as per the provisions of Schedule 11 of the Local Government Act. This is also important given that the city will continue to rely on onsite sanitation and experiences from across the continent suggest that water utilities tend not to have an interest in promoting onsite sanitation as there are no immediate financial gains. The focus therefore, which falls within the public health mandate of the local authorities, would be to promote and enforce construction of household latrines. Currently Juba City Council has two departments handling sanitation matters namely, Department of Public Health and Department of Environment and Sanitation. It is proposed that for effectiveness, the two should be merged into one Department of Environment and Sanitation (the Department) which would then take responsibility for development and enforcement of proper toilet design standards as well as planning for adequate and proper location of public toilets in relation to homes, markets and bus stations. The department would also be responsible for hygiene promotion activities, as well as enforcement of environmental standards. In this way, the council becomes the central coordinating body for improvement of sanitation at the household and communal level and is the body through whom all other agencies interact in sanitation improvement activities.

Since the council has responsibilities at both city and block level, there is need to distinguish functions between these two tiers to avoid both duplication and competition. It is proposed that while the Department would formulate the rules and guidelines, including hygiene promotion programs, the blocks should be the main players in implementation of these city council activities including policing compliance as they are closest to the target populations.

7.2.1.2 Transportation of Fecal Sludge

It is proposed that in the five year planning period, establishment and enforcement of operational standards for the exhauster tankers should be the sole responsibility of JCC under the Department of Environment and Sanitation. The department would be responsible for ensuring that trucks are in good working order to carry waste without polluting the environment. The department would also issue sanitary licenses for all trucks. The licensing is a key part of regulation and therefore it is key that only one centralized unit in the council take full responsibility for both ease of monitoring and accountability.

The City Council must also set up a parking area for the trucks to stop the current practice where trucks are parked at premises all over the city. The city council is not only able to provide land required for this function, but would also be able to better monitor the activities of the truckers as well as generate revenue from them for the parking.

As the private sector has shown a tremendous willingness to invest in the exhauster tanker business, it is proposed that procurement and management of tankers should remain the domain of the private sector. If necessary government can enact laws that make it easier for the private sector to procure and or maintain the trucks, although presently, there is no indication that any such measures are required.

7.2.1.3 Treatment of Fecal Sludge

Three key issues are considered here. Firstly, it is paramount that there is a transition from the current arrangements to a situation where ownership, operations and revenues are all put together under a single entity to lay a foundation for delivering the entire system to a water and sewerage company/corporation. The ultimate aim should be to have piped water and sewerage managed by one entity so that water and sewerage systems can be planned and developed concurrently. Secondly, while Juba County has managed the lagoon since it was commissioned in 2010, it is however more ideal that the city that is producing the fecal waste should also take responsibility for managing that waste as it is directly in their interest to do so. Thirdly, even though the Ministry of Health (CES) has already started this process with the Ministerial Order of September 2014, which could well be within their scope, it would be preferable to have the system owned and operated at the local level rather than the state level from an end user standpoint. This would also be in line with the provisions of the Local Government Act, the National Water Policy and the WASH Strategic Framework.

Based on these observations, it is proposed that in the five year planning period of the Investment Plan, the ownership and operation of the Roton Wastewater Lagoon, including relevant revenue streams be transitioned from both the County and the Minister of Health, to the Department of Environment and Sanitation within the Juba City Council. Within this department, a Liquid Waste Management Unit (LWMU) could be established which would have overall responsibility and accountability for the lagoon. Staff of this unit should include engineers who can either be seconded from the Ministry of Water Resources but preferably be hired directly by the City Council. Alternatively, JCC could engage a private company to operate the lagoon on their behalf which would report to the LWMU. Whatever format this unit takes, it will be important that ring fencing and transparency of revenues from the lagoon is established and safeguarded. Juba City Council would also be responsible for sourcing financing for completion of the lagoon.

It must be emphasized that the management of the lagoon by the City Council is proposed here as an interim measure to effect immediate improved management and operation of the lagoon. Ultimately, the lagoon must be managed together with the piped water and sewerage network by one entity.

Another possible viable option would be for the lagoon to be passed to the SSUWC which is already responsible for piped water supply in the city. However this option may be complicated by the fact that the SSUWC is currently overwhelmed by water demands of which they only supply a very small proportion. It may therefore be in the interest of the City for the Corporation to continue focusing on solving the water supply problems without being derailed with the burden of liquid waste as well. Most importantly however, the transitioning of the lagoon from the County and the State is more of a political than a technical issue. In the recent past, the mayor has created significant impetus on getting the lagoon to be better managed which partially accounts for the Ministerial Order of September 2014. The City also has much closer relations with the County and the State government and may therefore provide an easier option for the transitioning. This is especially so given that the State already second staff to the City meaning that effectively the Department of Environment and Sanitation even though based in the City Council is still serving the Minister. Secondly, as the major fall out on the transitioning has to do with loss of revenue from the tanker businesses, having the city at the center provides a much easier way of working out how the revenue could be shared amongst the local actors, should this be desired or perceived as necessary.

Managing and upgrading small lagoons –As part of the process of integrating management of the piped sewerage system, it is proposed that the Juba City Council should also take over management of the two small lagoons at Kololo and Hai Amarat.

Acquisition of land for new wastewater treatment plant: it is recommended that the Juba City Council acquire and secure this land in collaboration with the Juba County, as having a wastewater treatment facility is in the interest of the city, regardless of which agency ultimately takes responsibility for water borne sewerage services.

Setting effluent standards for the lagoon should be done by Ministry of Environment (RSS) in conjunction with CES. The ministry should work closely with the Ministry of Dams, Electricity, Irrigation and Water Resources, Ministry of Lands, Housing and Physical Planning and the South Sudan Urban Water Corporation in setting these standards. This will also require that the proposed Environmental Law be fast tracked and passed into law to enable the ministry implement its activities effectively.

7.3 Institutional Arrangements 2021-2025

7.3.1 Containment of Fecal Sludge

7.3.1.1 Household Toilets and Public Toilets:

Regulatory oversight of this activity continues to be the responsibility of the City Council under the Department of Environment and Sanitation.

7.3.2 Transportation of Fecal Sludge

Enforcement of operational standards for the exhauster tankers remains the responsibility of the City Council as organized in the first five years of the plan.

Procurement of tankers should remain the domain of the private sector.

Construction and management of sewer network is a specialized technical function which should be undertaken by the entity responsible for piped water supply in the city. It is anticipated that by this time,

the Water Law would have been passed and that a water and sewerage company would have been established which would belong to the Juba City Council but possibly be managed as a private company.

7.3.3 Treatment of Fecal Sludge

Expansion and management of Roton Lagoon or a new treatment plant should be undertaken by the agency responsible for piped water supply.

Decommissioning of small lagoons should be undertaken by the agency responsible for piped water supply.

7.4 Institutional Arrangements 2026-2030

7.4.1 Collection and Storage of Fecal Sludge

7.4.1.1 Household Toilets and Public Toilets:

Overall responsibility for public toilets remains with the Juba City Council with continued active participation of the private sector.

Even though there would be a small sewer network within the city at this time, it is proposed that responsibility for promotion of household latrines should remain with the city council. This is essentially because Juba will still be heavily reliant on onsite sanitation and would, in all likelihood, mirror the other capital cities on the continent where onsite sanitation remains with the city council while waterborne sewerage is a function of the water and sewerage company.

7.4.2 Transportation of Fecal Sludge

Since there would still be a large number of tankers operating in the city, it is proposed that establishment and enforcement of operational standards for the exhausters tankers remains the responsibility of the city council. While the water utility may be managing the wastewater treatment plants, enforcement of citywide regulations on routing, environmental standards etc., would still remain the function of the local authority that has the mandate to pass and enforce by laws.

Procurement of tankers would continue to be the domain of the private sector.

Extension and management of sewer network would be undertaken by the agency responsible for piped water supply and sanitation.

7.4.3 Treatment of Fecal Sludge

Expansion and or construction of a new wastewater treatment facility is to be undertaken by the agency responsible for piped water supply and sanitation.

It is also anticipated that by this time, both water supply and sanitation would be under one ministry which would also have developed a comprehensive urban water supply and sanitation policy with a related regulatory framework.

The roles and responsibilities of the different agencies discussed above are summarized in Table 27 below.

Table 27: Proposed Institutional Arrangements

Activity	Institution	Responsibilities		
		2015-2020	2021-2025	2026-2030
Collection and Storage of fecal Sludge	Juba City Council	Promotion and enforcement of Household Toilets and hygiene Construction and regulation of public toilets	Promotion and enforcement of Household Toilets and hygiene Construction and regulation of public toilets	Promotion and enforcement of Household Toilets and hygiene Construction and regulation of public toilets
	Private Sector	Construction and operation of public Toilets	Construction and operation of public Toilets	Construction and operation of public Toilets
Transportation of Fecal Sludge	Private Sector	Procurement and operation of tankers	Procurement and operation of tankers	Procurement and operation of tankers
	Juba City Council	Licensing and regulation of tankers Provision and operation of tanker park station	Licensing and regulation of tankers Provision and operation of tanker park station	Licensing and regulation of tankers Provision and operation of tanker park station
Treatment of Fecal Sludge/ sewerage	Juba City Council	Operation and completion of Roton Lagoon Operation of small lagoons	N/A	N/A
	Water Utility	N/A	Operation and Expansion of Roton Lagoon Decommissioning of small lagoons	Operation and Expansion of Roton Lagoon
	Ministry of Environment	Regulation and enforcement of environmental standards	Regulation and enforcement of environmental standards	Regulation and enforcement of environmental standards

8.0 Recommended Priority Actions

Three activities are prioritized because of their impact on the viability of the plan and sustainability of the sanitation program in Juba.

8.1 Improved Management of Roton Lagoon

Firstly, proper management of the Roton Wastewater Lagoon is key to all other activities. As the only public treatment facility in the city, it is essential that the lagoon remains fully operational so that the city can continue to dispose of fecal waste in an environmentally acceptable manner. However, the continued operation of the lagoon requires proper management so that it does not become an environmental hazard.

8.2 Expansion of Roton Lagoon

The lagoon is currently the only part of the public infrastructure with a reliable income stream. It is also the most obvious possible place for a public –private partnership due to the reliable income stream. To maintain this, it is important to expand the lagoon to its full capacity by completing construction.

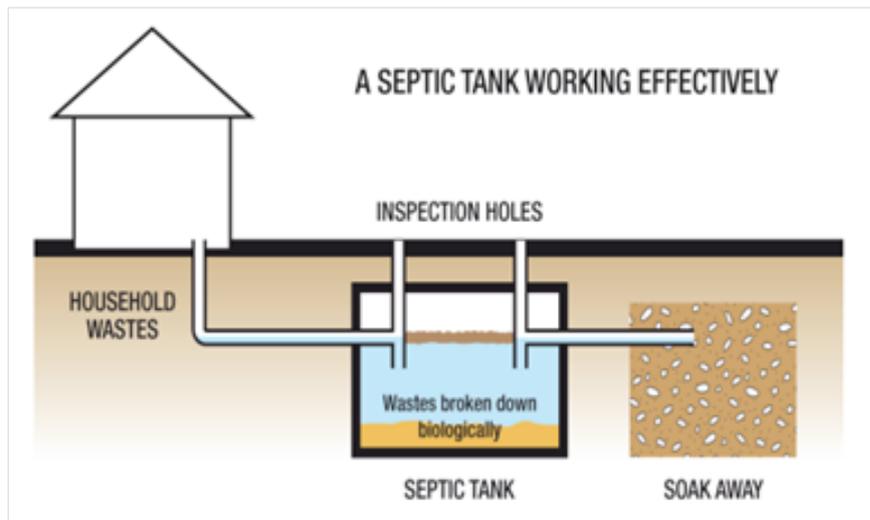
8.3 Improved Management of the Hai Amarat and Kololo Lagoons

These are prioritized because of the negative public health impacts as they are located within residential neighborhoods.

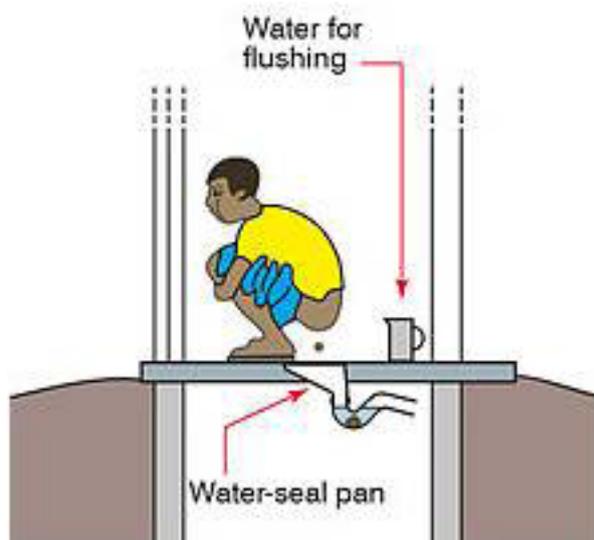
Annexes

Annex I: Typical Configurations for Sludge Containment

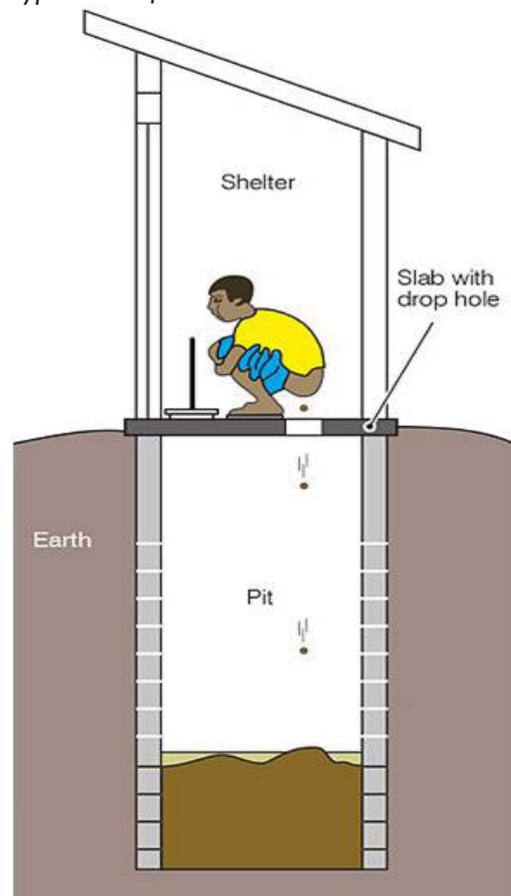
Typical Septic Tank with Soak Away



Typical Lined Pit Latrine



Typical Pour-flush Pit latrine



Annex 2: Household and Public Toilets Projections

FIVEYEAR PLAN 2015 - 2020		
Parameter	Value	Notes
2015 Population	528,550	from projections
person per households	9.36	from Fecal Sludge Study
2015 households	56,469	
Private toilet coverage	40%	from Fecal Sludge Study
2015 households with toilets	22,588	
2020 Population	697,693	from projections
person per households	9.36	from Fecal Sludge Study
2020 households	74,540	
Private toilet coverage growth	25%	Due to marketing and awareness efforts
2020 Private toilet coverage	50%	
2020 households with toilets	37,270	
2020 total coverage goal	55%	
2020 households w coverage	40,997	
2020 households served by CABs	3,727	
Households per CAB	80	8 households per toilet; 10 toilets per CAB
Total CABs required	47	
Total private toilets required	14,682	
TEN YEAR PLAN 2021 - 2025		
Parameter	Value	Notes
2020 Population	697,693	from projections
person per households	9.36	from Fecal Sludge Study
2020 households	74,540	
2020 Private toilet coverage	50%	
2020 households with toilets	37,270	
2025 Population	920,966	from projections
person per households	9.36	from Fecal Sludge Study
2025 households	98,394	
Private toilet coverage growth	25%	Due to marketing and awareness efforts
2025 Private toilet coverage	63%	
2025 households with toilets	61,496	
2025 total coverage goal	70%	
2025 households w coverage	68,876	

2025 households served by CABs	7,380	
Households per CAB	80	8 households per toilet; 10 toilets per CAB
Total CABs required	92	
Total private toilets required	24,226	
FIFTEEN YEAR PLAN 2026 - 2030		
Parameter	Value	Notes
2025 Population	920,966	from projections
person per households	9.36	from Fecal Sludge Study
2025 households	98,394	
2025 Private toilet coverage	63%	
2025 households with toilets	61,496	
2030 Population	1,215,688	from projections
person per households	9.36	from Fecal Sludge Study
2030 households	129,881	
Private toilet coverage growth	25%	Due to marketing and awareness efforts
2030 Private toilet coverage	78%	
2030 households with toilets	101,470	
2030 total coverage goal	85%	
2030 households w coverage	110,399	
2030 households served by CABs	8,929	
Households per CAB	80	8 households per toilet; 10 toilets per CAB
Total CABs required	112	
Total private toilets required	39,974	

Annex 3: Investment Plan Cost Estimates

Public Toilets (Community Ablution Blocks) and Household Toilets			
	Planning Period		
	2015-2020	2021-2025	2026-2030
Period End Population	697,693	920,966	1,215,688
Target Coverage	55%	70%	85%
Population Covered	383,731	644,676	1,033,335
Avg. persons per House	9.36	9.36	9.36
Households w/ coverage	40,997	68,876	110,399
Target CABs per household	8	8	8
Private Toilets Required		24,226	39,974
Private Toilets Cost	\$14,682,352	\$24,226,153	\$39,973,602
CABs Required (at 10 toilets/CAB)	47	92	112
CAB cost	\$2,795,352	\$5,534,649	\$6,697,000
Total Costs	\$17,477,598	\$29,760,802	\$46,670,602
Exhauster Trucks			
	Planning Period		
	2015-2020	2021-2025	2026-2030
Avg Truck Volume (l)	18,000	18,000	18,000
Avg. Trips per day	2.3	2.3	2.3
Additional Sewerage, end of period (l/day)	1,990,198	3,013,909	3,425,297
New Trucks Required	48.07	72.80	82.74
Unit Cost	\$83,773	\$83,773	\$83,773
Total Cost	\$4,027,186	\$6,098,678	\$6,931,125
Lagoon Capacity			
	Planning Period		
	2015-2020	2021-2025	2026-2030
Initial Capacity (m3/day)	3,300.00	6,500.00	9,700.00
Initial Flow (m3/day)	2,300.00	4,290.20	7,304.11
Additional Flow, end of period(m3/day)	1,990.20	3,013.91	3,425.30
Total Flow (m3/day)	4,290.20	7,304.11	10,729.40
Expansion Capacity (m3/day)	3,200.00	3,200.00	3,200.00
End of Period Capacity (m3/day)	6,500.00	9,700.00	12,900.00
Unit Cost (\$/m3/day)	\$1,200	\$750	\$1,000
Expansion Cost	\$3,840,000	\$2,400,000	\$3,200,000
Additional Studies	\$200,000	\$ -	\$ -
Land Purchase	\$ -	\$400,000	\$400,000
Total Cost	\$4,040,000	\$2,800,000	\$3,600,000

	Planning Period		
	2015-2020	2021-2025	2026-2030
Sewer Network			
Gravity Line			
Quantity (m)	0	2,500	6,000
Unit cost (\$/m)	0	\$164.39	\$164.39
Cost	0	\$410,975	986,339
Manholes			
Quantity (ea)	0	25	75
Unit cost (\$/ea)	0	\$3,310.00	\$3,310.00
Cost	0	\$82,750	\$248,250
Force Main			
Quantity (m)	0	6,000	500
Unit cost (\$/m)	0	\$164.00	\$131.20
Cost	0	\$984,000	\$65,600
Pump Stations			
Quantity (ea)	0	3	1
Unit cost (\$/ea)	0	\$200,000	\$80,000
Cost	0	\$600,000	\$80,000
Total Cost	0	\$2,077,725	\$1,380,189
Rehab small treatment lagoons (2015-2020 planning period)			
Clean Ponds	\$ 200,000		
Fencing and other barriers	\$ 300,000		
Receiving Wells	\$ 80,000		
Total	\$ 580,000		
Connect Tong Ping lagoon to Roton			
Force Main			
Quantity (m)	2,200		
Unit cost (\$/m)	\$ 131.20		
Cost	\$ 288,640		
Pump Stations			
Quantity (ea)	1		
Unit cost (\$/ea)	\$ 200,000		
Cost	\$ 200,000		
Total Cost	\$ 488,640		

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