SFD Report

Kafue
Zambia

Final Report

This SFD Report - Initial level - was prepared by GOPA Infra and BORDA Zambia on behalf of the GIZ Reform of the Water Sector Programme Phase II

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SFD Report Kafue, Zambia, 2023

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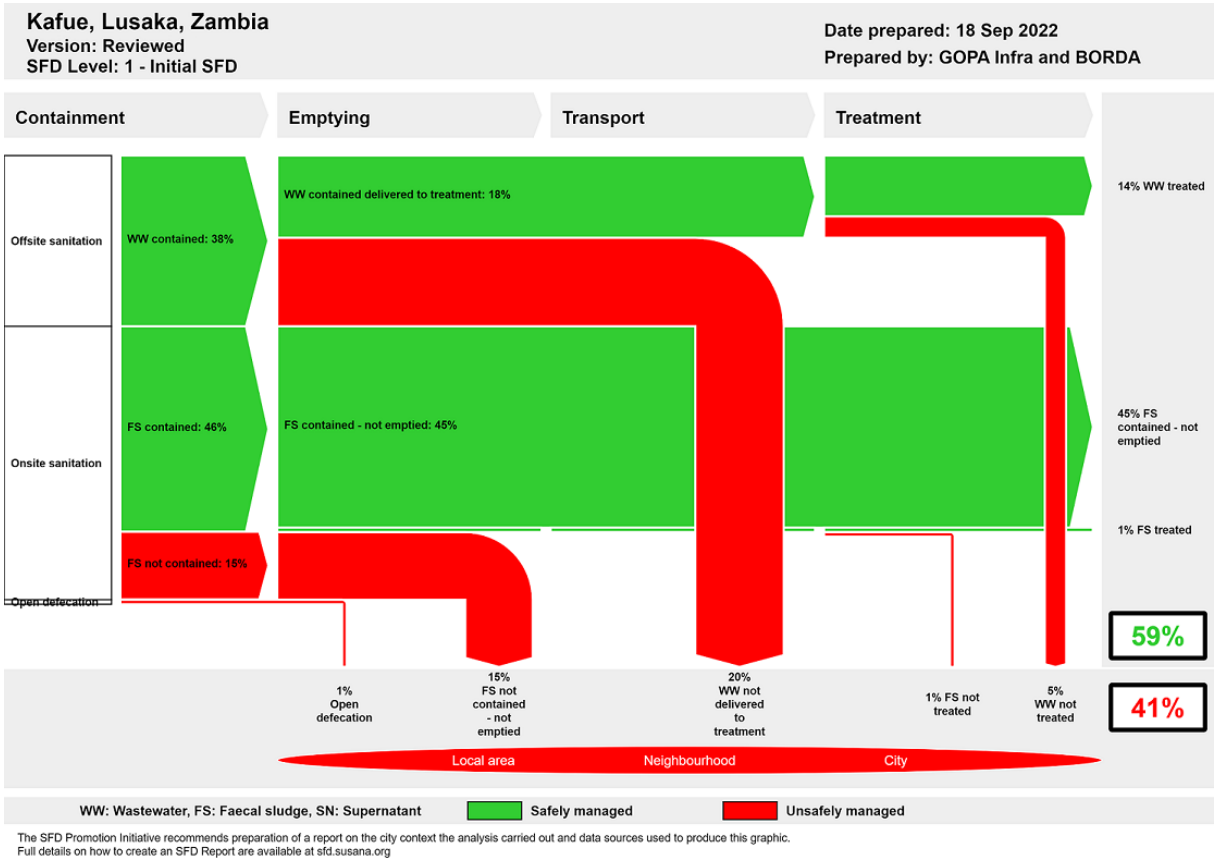
1. The SFD Graphic



The SFD Promotion Initiative recommends preparation of a report on the city context the analysis carried out and data sources used to produce this graphic.
Full details on how to create an SFD Report are available at sfd.susana.org

2. Diagram information

SFD Level:

This is an Initial level SFD report

Produced by:

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Collaborating partners:

- GIZ Zambia Water and Energy Cluster
- Lusaka Water Supply and Sanitation Company (LWSC)
- Ministry of Health (MoH)

Status:

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3. General city information

Kafue District is one the six districts serviced by LWSC and Kafue Town, the area of interest in this study, is in this district. The town is located about 45 km south of Lusaka City, the nation's capital. It is located on the northern bank of the Kafue River, whose water is the major source of water supply for Chilanga District, Lusaka City and Kafue Town itself.

Kafue town has an industrial zone critical to economic narrative for the country. It is home of the oldest fertiliser plant, steel and iron complex, fibreglass fishing boat assembly plant among others. Within the vicinity of Kafue Town is an active and productive greenbelt.

The population of Kafue Town for 2021 was about 92,391 (MoH, 2021). According to Zambia Statistical Agency, the population projection for the district for the same year (i.e., 2021) was about 346,589 from the 244,628 in 2011 implying that the town contributes about 26.7% of the district's population. The SFD graphic boundaries for Kafue were chosen to

follow Ministry of Health (MoH) Centre Catchment areas falling within the town.

4. Service outcomes

Kafue Town currently employs three sanitation options which include: onsite sanitation, offsite sanitation and Open Defecation (OD). In terms of coverage for the three sanitation options, offsite sanitation is estimated at 38%, onsite sanitation at about 61%, while OD accounts for about 1%.

About 38% of the population of Kafue uses offsite sanitation. Several areas within the town have a reticulated sewer network. Most of the treatment is provided by an activated sludge Wastewater Treatment Plant (WWTP) connected to a series of three maturation ponds. A smaller plant, Nangongwe Stabilisation Ponds, also services Nangongwe Compound although it still discharges its effluent to the Chawama WWTP. The sewerage network has a total of five Sewage Pumping Stations (SPSs), all which are supposed to pump wastewater to the Chawama treatment plant.

Onsite sanitation systems in Kafue comprise pit latrines and septic tanks. Pit latrines are predominant in peri-urban areas. Most of these latrines are shared as the housing units in peri-urban areas usually accommodate more than one household. Anecdotal data puts emptying of pit latrines in Kafue at 0%.

Septic tanks are normally used in low, medium and high-income areas located in areas where there is no sewerage network. They also serve some commercial, industrial and public buildings that cannot connect to the network.

The status of containment structures in the town remains unknown. During interviews with key informants, it was established that during the rainy season, groundwater level rises and causes septic tanks to overflow. This scenario is common in Shikoswe, Soloboni, Mutendere and Nangongwe townships. This overflow of septic tanks has the potential to contaminate groundwater; especially that household owners have constructed hand dug wells within their yards, some which are as small as 400 m^2.

Emptying is usually carried out by formal emptying service providers. Generally, the emptying rate is very low and estimated at a 3.6%. The formal disposal point for emptied septage is the Chawama WWTP.

Overall, the SFD graphic shows that 41% of the population has their excreta unsafely managed while 59% has their excreta safely managed. However, around half (24%) of the safely managed sanitation is from the population using septic tanks that have not been emptied. This is a temporary situation as when these tanks become full, they will require emptying. If they are not emptied, they will overflow causing a significant risk to public health.

5. Service delivery context

The Government Republic of Zambia (GRZ) has put up a very clear policy, regulatory and legal framework for water supply and sanitation services to guide the vision to achieve universal access to sanitation by 2030. To achieve this, the important policies that have been put in place include: the Zambia Vision 2030; the 7th National Development Plan 2017 – 2021; National Water Supply and Sanitation Policy of 2020, and UN Sustainable Development Goals (SDGs) 2015 – 2030. All these policy documents set clear objectives and targets on sanitation service improvement for both urban, peri-urban and rural areas which include Kafue District. In addition, the Framework for Provision and Regulation of Urban Onsite Sanitation and Faecal Sludge Management and the Framework for Provision and regulation of Rural Water Supply and Sanitation in Zambia sets a robust institutional arrangement that clearly specifies the roles and responsibilities of all key players in the Sanitation Sector. The following are the major sector players:

- Ministry of Water Development and Sanitation (MWDS).
- National Water Supply and Sanitation Council (NWASCO).
- Zambia Environmental Management Agency (ZEMA).
- Kafue District Council (KDC).
- Water Resources Management Authority (WARMA).
- LWSC, and
- Cooperating partners such as International Funding Institutions (IFIs) and Non-Governmental Organizations (NGOs).

In addition, several laws and regulatory tools exist which provide a clear legal and regulatory framework for sanitation at both national and local level. These include the following:

- The Water Supply and Sanitation Act No. 28 of 1997: Mandates NWASCO to regulate water supply and sanitation provision in urban, peri-urban and rural areas as well as provides for the formulation of utility

companies which are responsible for water supply and sanitation services provision.

- Local Government Act Chapter 281, Volume 16 of the Laws of Zambia: Mandates Local Authorities (LAs) as providers of water supply and sanitation services in their respective districts. Service provision is delegated to the utility companies who are owned by the local authorities.
- The Public Health Act Chapter 295, Volume 17 of the Laws of Zambia: Mandates LAs to enforce public health protection.
- The Environmental Management Act No. 12 of 2011: Mandates ZEMA to license, regulate and enforce environmental safeguards which include treated wastewater effluent discharge standards.
- Water Resources Management Act of 2011: Establishes WARMA to set, regulate and enforce standards on surface and groundwater quality which are often receiving bodies of treated effluent.
- The Statutory Instrument No. 112 of 2013: Sets limits and standards for environmental protection including licensing of vehicles for transportation of faecal sludge and treatment facilities.
- Statutory Instrument No. 100 of 2011: Provides for LAs to manage solid waste in the areas of operation. Poorly managed solid waste systems lead to indiscriminate disposed of municipal waste into onsite sanitation facilities, making emptying services challenging.

6. Overview of stakeholders

On a national level, Ministry of Water, Development and Sanitation (MWDS) is responsible for Water Resource Management (WRM), urban and rural Water Supply and Sanitation (WSS). The Ministry's main responsibilities include development of National Policies, Guidelines and Strategies, including resource mobilization. The Ministry of Local Government (MLG) is in charge of solid waste management and has the overall mandate to coordinate LAs. NWASCO is responsible for regulating the provision of WSS and ensure efficiency and sustainability. The mandate of NWASCO with regard to WSS has been outlined in the 2021-2026 Strategic Plan. As an extension to its mandate, NWASCO will regulate rural water supply and sanitation, onsite sanitation services and faecal sludge management. The Regulator further look to effectively regulate water supply and sanitation service delivery in order to ensure improved and inclusive service provision. The 2021-2026 Strategic Plan is an important framework to provide guidance and regulation among the eleven Commercial Utility Companies.

LWSC is one of the eleven utility companies in Zambia and it is mandated to provide water and sanitation services to selected towns in Lusaka Province in which Kafue Town is located.

The MoH services that include public health stretches across all the corners of the country. The function of public health is executed through its directorate of public health. Under the function, the department is charged with the responsibility to develop and implement programs and projects aimed at preventing, controlling and eliminating diseases in order to promote health and prolong life. The department is also tasked to conduct public health research and surveys to determine the health status of communities. This role (public health research and surveys) was particularly important to this study, in that it provided necessary data on prevailing sanitation options in Kafue. Table 1 gives an overview of key stakeholders with their responsibilities.

Table 1: Overview of Key Stakeholders (Source: NWASCO, 2018).

Stakeholder		Responsibility
Group	Stakeholder	
Public	MWDS	Policy and Laws
	NWASCO	Service Provision regulation (setting service standards and regulation of emptying and transportation tariffs)
	ZEMA	Environmental protection regulation (licensing of transportation vehicles/ end use, treatment standards)
	KDC	Enforcement of sanitation systems and public health standards.
Service Providers	LWSC	Sanitation service provision to rural, urban and peri-urban areas (PUAs)
Customer	Households, Commercial and Public institutions.	Responsible for investment in onsite sanitation facilities e.g. construction of standard containment facilities at a household level and connecting to sewer systems.

Cooperating Partners	GIZ, African Development Bank.	Sanitation improvement financing and capacity building of ZEMA, KDC, WARMA, NWASCO, LWSC and MWDS to effectively manage sanitation services.

7. Process of SFD development

A combination of desk review and field research were employed to collect data for this study. During field research, several Key Informant Interviews (KIIs) were conducted to collect data on the sanitation status in the town. Respondents for these interviews included staff from LWSC Head Quarters and Kafue office and EHTs from MoH. Data were also collected through review of literature on sanitation provision in the district and specifically on the town which was the area of interest in this study.

Site visits to all sanitation infrastructure in the town including the sewerage system (i.e., the network, associated sewage pumping stations, and the wastewater treatment plant) were also undertaken to help capture data on aspects which were not addressed by the KII and secondary data sources.

8. Credibility of data

Much of the data that was collected enjoys substantial amount of credibility especially that both LWSC and MoH collect their data on a regular basis. However, there is need to agree on how to disaggregate and quantify households using more than one option of sanitation as some households had dual options within their premises (i.e., onsite and offsite).

In addition, LWSC was not able to accurately quantify the amount of wastewater that is received at the treatment plant and also how much ends up in the environment, considering that there are no flow metres installed to measure the quantity received in pumping stations and treatment plants.

9. List of data sources

The list of data resources include the following:

- British Geological Survey (2001). Groundwater Sanitation Risk (worldbank.org)
- GReSP (2013). Zambia - Groundwater Resources Management Support Programme.
- GReSP (2015). Zambia - Groundwater Resources Management Support Programme.
- NWASCO (2020). 2021-2026 Strategic Plan.
- Zambia Statistical Agency (2012). 2010 Census of Population and Housing: National Analytical Report.
- KIIs with staff from LWSC Head Office.
- KIIs with staff from LWSC Kafue Office.
- KIIs with staff from MoH, Kafue-based Health Centres.

Kafue, Zambia, 2023

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Abbreviations

BMZ	German Federal Ministry of Economic Cooperation and Development
CU	Commercial Utility
EHT	Environmental Health Technologist
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GRZ	Government of the Republic of Zambia
KDC	Kafue District Council
KII	Key Informant Interviews
LAs	Local Authorities
LWSC	Lusaka Water and Sanitation Company Limited
MLG	Ministry of Local Government
MoH	Ministry of Health
MWDS	Ministry of Water Development and Sanitation
NUSS	National Urban Sanitation Strategy
NUWSSP	National Urban Water Supply and Sanitation Programme
NWASCO	National Water and Sanitation Council
OD	Open Defecation
SDG	Sustainable Development Goal
SFD	Shit Flow Diagram
SPS	Sewage Pumping Station
WARMA	Water Resources Management Authority
WRM	Water Resources Management
WSS	Water Supply and Sanitation
WWTP	Wastewater Treatment Plant
UN	United Nations
ZEMA	Zambia Environmental Management Agency

1 City context

Kafue District is one the six districts serviced by Lusaka Water and Sanitation Company Limited (LWSC). Kafue Town is located about 45 km south of Lusaka City, the nation's capital. The town is accessed through the Great North Road and a railway line which passes through the town, linking it to Mazabuka and Lusaka. It is located on the northern bank of the Kafue River, whose water is the major source of water supply for Chilanga District, Lusaka City and Kafue Town itself. The Kafue River creates a natural boundary between Mazabuka and Chikankata districts, on the south and Chirundu on the South-east. On the upper north is the recently created Chilanga District which was curved out from Kafue District (Figure 1).

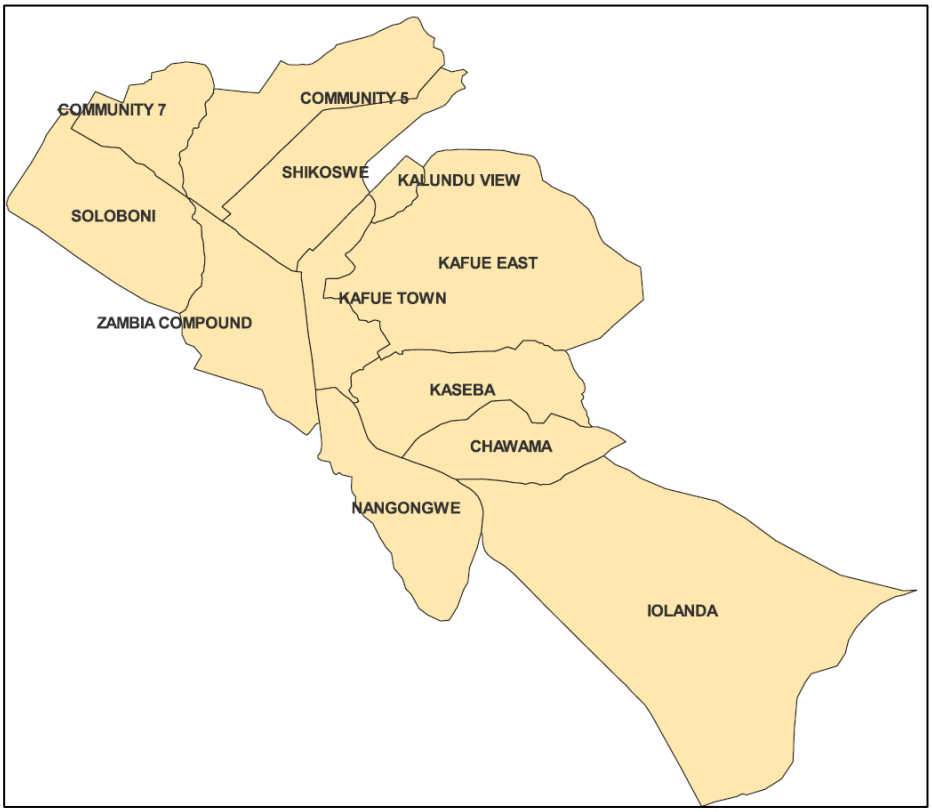

Figure 1: Map of Kafue showing service areas for LWSC (Source, LWSC GIS Department).

1.1 Climate

Kafue District lies within the tropical continental highland climate mainly comprising two seasons namely the dry and the wet seasons. The dry season is characterized by cool dry and hot dry weather covering the period between May and October and the wet season running from around November to April. Due to the combined effect of low latitude (16 - 18°S), continental position and high elevation above sea level, the climate shows a combination of a clear division into a dry and a rainy season.

Annual rainfall for the thirty-year period from 1963 to 1993 averages at 857 mm. Rainfall amounts usually peak in January with monthly totals ranging from 206 to 237 mm. About 82% of the total annual rainfall occurs during the four-month period from December to March (GReSP, 2015).

The topography of Kafue is mostly mountainous with an elevation ranging from 1,200 to 1,300 m above sea level (GReSP, 2013). The southern part of the district is bounded by Kafue River which serves as a delineating boundary with Mazabuka District of Southern Province.

With respect to hydrogeological aspects, particularly for the town area, there is no documented data.

1.2 Population

Kafue District had a projected population annual growth rate of about 1.7% for the period 2011 to 2020. This growth rate translates into a population of 346,589 in 2020 from the initial 244,628 in 2011. With respect to Kafue Town, the headcount population obtained from Ministry of Health's (MoH's) Environmental Health Technologists (EHTs) in the health centres puts the population of Kafue Town at 92,359. This population is drawn from six town-based health centre catchment areas that include: Nangongwe, Railway, Kafue East, Mutendere, Shikoswe and Estates. All these districts are covered by the six health catchment areas which give the total populations. Therefore, for districts with gaps in population, data from the MoH catchment areas were used to cover these gaps. A summary of the estimated population based on data from both LWSC and MoH is presented in Appendix 1. However, in terms of population, these 12 districts have gaps as LWSC only recorded the population that has access to water supply.

The town is divided into planned and unplanned settlements. Planned settlements are basically areas along the main road that cuts across town. They also include the industrial area and Civic Centre where the famous Kafue Estates in located. The unplanned settlements, include places like Soloboni, parts of Mutendere, Nangongwe, Community 7, parts of Chawama and other similar areas. These unplanned settlements are also referred to as Peri-urban Areas (PUAs).

2 Service Outcomes

2.1 Overview

This section presents the range of infrastructure technologies, methods and services designed to support the management of wastewater and faecal sludge through the sanitation service chain in Kafue Town (Figure 2). The section also provides some general information on the current condition and capacities of the different systems. Details on quantitative estimations are presented in section 2.2.

List A: Where does the toilet discharge to? (i.e. what type of containment technology, if any?)	List B: What is the containment technology connected to? (i.e. where does the outlet or overflow discharge to, if anything?)									
	to centralised combined sewer	to centralised foul/separate sewer	to decentralised combined sewer	to decentralised foul/separate sewer	to soakpit	to open drain or storm sewer	to water body	to open ground	to 'don't know where'	no outlet or overflow
No onsite container. Toilet discharges directly to destination given in List B		T1A1C2			Significant risk of GW pollution Low risk of GW pollution					Not Applicable
Septic tank					T2A2C5 T1A2C5					
Fully lined tank (sealed)					Significant risk of GW pollution Low risk of GW pollution					
Lined tank with impermeable walls and open bottom	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution	Significant risk of GW pollution Low risk of GW pollution					Significant risk of GW pollution Low risk of GW pollution
Lined pit with semi-permeable walls and open bottom	Not Applicable									Significant risk of GW pollution Low risk of GW pollution
Unlined pit										Significant risk of GW pollution Low risk of GW pollution
Pit (all types), never emptied but abandoned when full and covered with soil										T2B7C10 T1B7C10
Pit (all types), never emptied, abandoned when full but NOT adequately covered with soil										
Toilet failed, damaged, collapsed or flooded										
Containment (septic tank or tank or pit latrine) failed, damaged, collapsed or flooded										
No toilet. Open defecation	Not Applicable							T1B11 C7 TO C9		Not Applicable

Figure 2: SFD selection grid.

2.1.1 Offsite sanitation

About 38% of the population of Kafue uses offsite sanitation system. Several areas within the town have a reticulated sewer network. Most of the treatment is provided by an activated sludge Wastewater Treatment Plant (WWTP) connected to a series of three maturation ponds. A smaller plant, Nangongwe Stabilisation Ponds, also services Nangongwe Compound although it still discharges its effluent to the Chawama WWTP. Details about the network and the treatment plant are discussed in ensuing sections.

Sewerage Network

The sewerage network has a total of five Sewage Pumping Stations (SPSs), all which are supposed to pump wastewater to the Chawama treatment plant. Some of these pumping

stations pump to other pumping stations which then pump to the plant (Figure 3). There is also a section of the network which discharges directly to the Chawama WWTP via gravity flow.

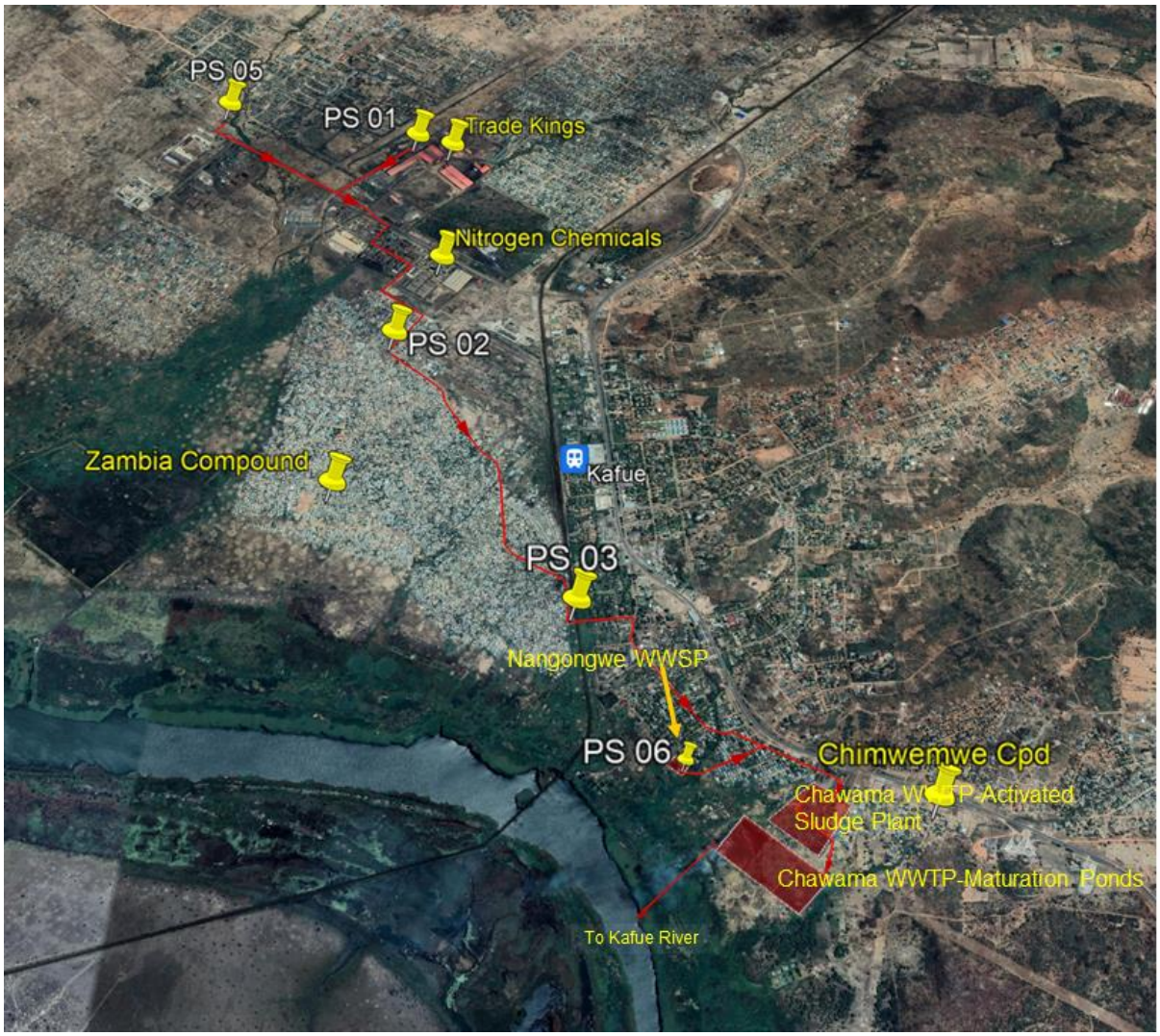

Figure 3: Location of Pumping Stations and Treatment Plants in Kafue (Note that the route for the lines is not known and therefore the presented routes in the Figure are imaginary).

During the time of the survey, which is the period between January and September, some pumping stations oscillated between operational and non-operational for various reasons. The latest status of the stations is described below.

Pump Station No. 01 (PS 01)

The pump station is located within the premises of Trade Kings (Universal Mining and Chemical Industries Limited). The stations services C5, C6 and Kafue General Hospital and is supposed to pump into the line from PS 05 to PS 02. However, this pumping station has been out of service since about November 2021. It was reported that the pump got burnt and was eventually removed. Therefore, the wastewater from the areas the station is supposed to service is currently on by-pass and goes directly into the environment.

Pump Station No. 02 (PS 02)

This station receives wastewater from PS 01 and PS 05. In addition, it services parts of Zambia Compound and FLASHBAT. Wastewater from this station goes to PS 03. The station is currently working perfectly in terms of pumping the wastewater although there a few technical challenges that require attention. The main pump is off the base hence it is no longer working. Currently, pumping is through an external pump which pumps the wastewater from the wet well of the pump station through an externally provided line to a Chamber about 30 m away (Figure 4). This chamber is where the original force main terminates and where the gravity line starts. Therefore, after being discharged in this chamber, the wastewater flows by gravity all the way to PS 03.

Figure 4: Pump Station No. 02 with the improvised flexible hose terminating at a manhole.

Pump Station No. 05 (PS 05)

This pump station services C7 and some industries. The line from this station discharges to PS 02. The station is in good working order.

Pump Station No. 05 (PS 05)

This is the biggest pumping station from the perspective of wastewater flow quantities being pumped. The station services Zambia railways area, Kafue Mall, Magistrate Courts as well as all the flows from PS 02 which include flows from PS 01 and PS 05. The station is in good working condition although it is on manual operation. This implies that switching on and off of the pumps is done manually. This is done to avoid damaging the pumps from debris and rags which access the well sump sometimes due to ineffective screens. It was reported that modification to the wet well were made a few years ago. However, the screens that were installed are too coarse to provide effective screening (Figure 5) and sometimes, foreign material like rags get rapped to the impellers making pumping difficult. When this happens, the rags have to be removed manually, otherwise, the pump can get damaged.

Figure 5: The Inlet Channel to PS 03 showing the coarse screens that have been provided.

However, it was reported that manpower is not sufficient to have the station manned for 24 hours. The station is therefore unmanned from around 18:00 hours to 05:00 hours. During this period, when the sump gets full, wastewater overflows into the bypass channel to the Kafue River (Figure 6).

Figure 6: Pump Station No. 02 (Note bypass channel on the RHS with evidence of wastewater flow in it).

Pump Station No. 06 (PS 06)

This pump station pumps wastewater from Nangongwe Wastewater Stabilisation Ponds (WWSPs) to the gravity line from SP 03 to Chawama Wastewater Treatment Plant (WWTP). It therefore specifically caters for Nangongwe Compound as the ponds exclusively service this compound. The station is automated and is in good condition.

Status of the network

A bigger portion of the network in Kafue was installed over 40 years ago and is therefore old. However, it could not be established in what condition it is from the perspective of its efficiency and effectiveness, although it was reported that leakages and spillages are reported sometimes. A clear understanding on the condition can only be possible if a detailed sanitation survey on the status of the sewerage infrastructure is undertaken.

Based on available information, it was estimated that the network has around 51.9% of the population contributing to generated wastewater that is not safely conveyed to the treatment plant. This took into account the population whose wastewater goes directly into the environment like for C5 and C6 and an estimation of what proportion of what goes to PS 03 overflows into the environment during periods when the pumping station is unmanned during night time. Details of these calculations are presented in Appendix 2. It should be noted that there is high possibility of blockages in the network upstream of the treatment plant. This assertion is supported by the low COD and BOD concentration in the influent which are even below the Zambia Environmental Management Agency (ZEMA) effluent Standards (Table 2). The possible explanation for this observation is that blockages in the system filter out most of the particulate organic matter contributing to the low organic matter reaching the plant.

Treatment System

Kafue has two WWTPs namely the Nangongwe and the Chawama treatment plants both which are located on the southern part of the town near Kafue River (Figure 7).

Figure 7: Wastewater Treatment Plants in Kafue.

The Nangongwe Wastewater Treatment Plant

The Nangongwe WWTP is a non-conventional plant comprising one circular facultative pond with a diameter of approximately 40 m in a series arrangement with three maturation ponds all with a diameter of 20 m. The discharge from these ponds goes to PS 06 where it then gets pumped to the gravity line section from PS 03 to the treatment plant.

At the time of the study, this set of ponds, especially the facultative pond, had accumulated so much sludge which drastically reduced the depth of the pond and hence the retention time (Figure 8).

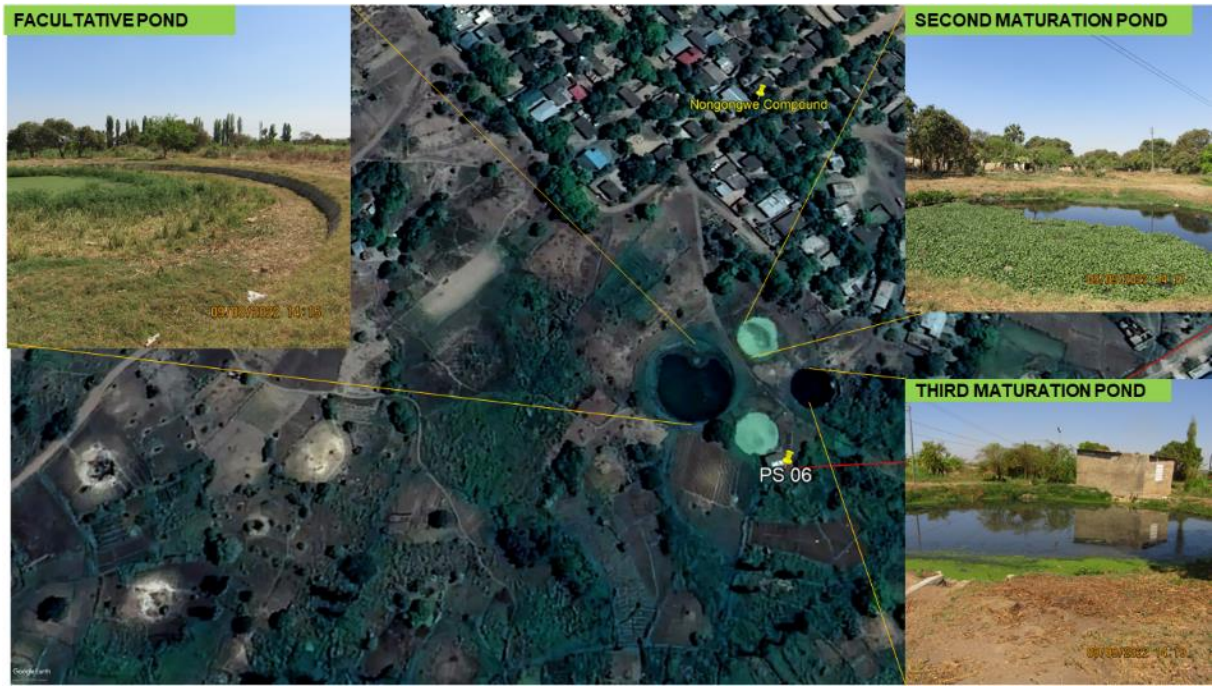

Figure 8: The Nangongwe WWTP with inserts of the units highlighting their current status.

Most parts of the facultative pond have developed sludge banks which have allowed grass to even grow. The first and second maturation ponds are overgrown with hyacinth. This reduces the effectiveness of the ponds to provide the required microbiological treatment. This is partly because weeds prevent UV light from penetrating into the deeper layers of the ponds rendering inactivation of microorganisms via UV light ineffective.

Secondly, the weeds introduce organic matter into the ponds impairing the mechanism of microbiological treatment through starvation. The build-up of sludge banks in the facultative ponds also impacts on organic matter removal as retention time is reduced. Therefore, wastewater going to the maturation ponds still has high concentration of organic matter thereby negatively impacting on the performance of the treatment system. Other parameters like settleable solids and turbidity are also negatively impacted upon due to reduced retention time. Table 1 presents results for the Nangongwe ponds over the last eight months.

Table 1: Effluent quality from the Nangongwe Ponds (Source: LWSC Lab).

Parameter	Unit	ZEMA Std	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
pH		6 to 9	7.18	6.54	6.55	7.06	7.25	7.19	7.07	6.03
SS	ml/L	0.5	2.3	6.0	3.0	3.1	4.2	2.0	0.1	0.1
Turbidity	NTU	15	133.8	125.4	240	112.5	118.0	576.0	126.0	96.6
Chloride	mg/L	800	46	71	92	42	39	48	79	70
TSS	mg/L	100	204	113	59	528	19	28	54	303.0
DO	mgO_2/L	5.0	3.4	5.2	6.9	5.1	9.1	4.5	7.0	6.2
BOD	mgO_2/L	50	13	12	10	12	15	15	13	59
COD	mgO_2/L	90	115	131	188	247	110	356	184	80
TC	ount/100n	25 000	3,800,000	2,300,000	3,320,000	3,120,000	2,250,000	3,480,000	3,280,000	192,000
FC	ount/100n	5 000	1,800,000	890,000	1,020,000	1,360,000	1,040, 000	1,530,000	1,460,000	9,200

However, as pointed out in the section above on the status of the sewerage network (Section on Pump Station No. 06 (PS 06)), the effluent from this plant is pumped to Chawama WWTP. This means that the current ineffective treatment by the ponds is not a direct threat to the environment.

The Chawama Wastewater Treatment Plant

The Chawama WWTP is an activated sludge plant which is connected to a series of three maturation ponds. The plant has a design capacity of 20,000 m^3/day. However, the current hydraulic loading is less than the design capacity because the connected population is lower and also because not all the wastewater that is collected ends up at the plant (See section above on Pump Station No. 01). The plant is also organically underloaded due to the nature of the influent which is diluted (Table 2).

Most of the units within the activated sludge treatment plant are in a relatively good condition. However, it was reported that the plant was on bypass since about two months before the visit. This bypassing was because of the damaged manifold in the influent receiving chamber which made it impossible to pump the wastewater to downstream treatment units (Figure 9).

Figure 9: The damaged manifold in the receiving well at Chawama Activated Sludge WWTP.

Due to no wastewater being received in the downstream units, all these units are currently not operational. In almost all the units, the water levels have gone down and algae has developed on the surface of the units (Figure 10).

Figure 10: The state of the Primary and Secondary aeration tanks at the time of the site visit.

The activated sludge plant discharges to three maturation ponds connected in a series arrangement. The ponds are provided as a “polishing” stage for the effluent from the activated sludge plant. It was observed that the ponds were in a state of abandonment resulting in weeds overgrowing in these facilities. Agricultural activities were also taking place both on the banks of the ponds and within the ponds (Figure 11). As explained under the Nangongwe WWTP, presence of weeds in maturation ponds impacts negatively on the treatment efficiency of the ponds.

Figure 11: State of the maturation ponds (LHS: Overgrown weeds in the ponds; RHS: Cultivation of sugarcane within the ponds).

Although the plant has challenges, the effluent quality from the plant is in compliance with the Zambia Environmental Management Agency (ZEMA) Effluent Standards for most of the parameters. Of the effluent samples analysed in terms of BOD and COD, 87.5% (n=16) conformed to the effluent standards. However, it should be noted that 100% of the influent samples (n=16) also conformed to the standards (Table 3) which is a clear indication that the treatment plant gets diluted influent in terms of organic matter.

In terms of microbiological parameters, only 50% of the samples complied to the ZEMA effluent standards. Computing the treatment effectiveness based on the results for all the parameters presented in Table 3, the percentage of adequately treated parameters is estimated at about 74% (n=80). This is what has been adopted as the percentage of population whose wastewater is adequately treated.

Table 2: Results of influent and effluent wastewater quality for the Chawama plant (Source: LWSC).

Source	Parameter	Unit	ZEMA Std	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Chawama Raw	pH			7.98	7.1	7.37	7.95	8.02	7.99	8.23	8.03
Chawama Final	pH		**6 to 9**	7.55	6.87	7.16	7.62	7.43	7.72	7.58	7.48
Chawama Raw	SS	ml/L		0.0	2.0	0.0	0.0	0.1	2.0	0.0	0.0
Chawama Final	SS	ml/L	**0.5**	10.0	10.0	1.5	0	0.1	0	0	0
Chawama Raw	Turbidity	NTU		21.7	117.2	18.1	17.3	15.7	49.9	75.2	78.3
Chawama Final	Turbidity	NTU	**15**	106.0	137.2	12.0	79.7	9.0	3.4	37.0	43.2
Chawama Raw	Chloride	mg/L		44	51	98	29	53	44	64	57
Chawama Final	Chloride	mg/L	**800**	58	74	90	28	44	19	53	55
Chawama Raw	TSS	mg/L		42	23	44	54	16	28	19	56
Chawama Final	TSS	mg/L	**100**	136	62	11	9	10	34	90	12
Chawama Raw	DO	mgO_2/L		ND	ND	ND	ND	ND	ND	ND	ND
Chawama Final	DO	mgO_2/L	**5.0**	4.7	8.3	13.7	7.8	8.3	8.2	10.3	9.6
Chawama Raw	BOD	mgO_2/L		8	4	4	4	6	16	4	18
Chawama Final	BOD	mgO_2/L	**50**	12	9	3	3	3	17	1	10
Chawama Raw	COD	mgO_2/L		17	85	19	62	23	36	22	76
Chawama Final	COD	mgO_2/L	**90**	208	143	43	31	20	32	10	47
Chawama Raw	TC	Count/100mL		5,800,000	4,600,000	400,000	700,000	3,800,000	1,600,000	3600000	7,800,000
Chawama Final	TC	Count/100mL	**25 000**	1,200,000	80,000	120,000	6,000	25,400	10,800	8400	7,400
Chawama Raw	FC	Count/100mL		1,900,000	450, 000	100,000	600,000	600,000	600,000	800,000	800,000
Chawama Final	FC	Count/100mL	**5 000**	420,000	20,000	20,000	2000	10,800	1100	1000	1100

2.1.2 Onsite sanitation

Onsite sanitation systems in Kafue comprise pit latrines and septic tanks. Pit latrines are predominant in peri-urban areas and most of them are of a polygamous type (i.e., combining the toilet and bathroom) as depicted in Figure 12. Most of these latrines are shared as most of the housing units in peri-urban areas usually accommodate more than one household.

Figure 12: Common type of latrine in Kafue with inserts of examples of user interfaces.

Anecdotal data puts emptying of pit latrines in Kafue at 0%. However, it is likely that informal pit emptying exists as it is not possible that all households have adequate space for new latrines when old ones get full. Unfortunately, without any study on this aspect, it is impossible to confirm whether indeed no pit emptying exists and to establish the prevalence of informal emptying, if at all it exists. Available data from interviews with key stakeholders (i.e., LWSC and MoH staff) indicates that most pit latrines are buried and abandoned when full.

Septic tanks are normally used in low, medium and high-income areas located in areas where no sewerage network exists. They also service some commercial, industrial and public buildings that cannot connect to the network. Construction of septic tanks is not regulated. As a result, most of these facilities are improperly constructed and many are not compartmentalized as required. Figure 13 presents examples of septic tanks that are found in the study area. Most of these facilities are sealed with concrete lids making it difficult to open. This is done to avoid using the standard aluminium or steel covers which are susceptible to vandalism by scrap metal dealers who would break the units to extract the metallic covers.

Figure 13: Common type of septic tanks in Kafue with inserts of examples of user interfaces.

For septic tanks, formal emptying is usually carried out by formal emptying service providers. Kafue has one vacuum tanker owned by Universal Mining and Chemical Industries Limited (Trade Kings) with a capacity of 6 m^3. This tanker usually provides services to commercial and industrial customers and charges K 1,800 (USD 92) per load. Operators from Lusaka with trucks of different capacities also provide services to the town. The fees for services for these trucks from Lusaka are not fixed. They are negotiated by the customer and the service provider but are usually higher than K1,800 (USD 92) due to distance.

The formal disposal point for emptied septage is the Chawama WWTP. The trucks empty the septage at a manhole just before the influent receiving chamber where it then mixes with the rest of the influent to the plant. The discharge fee charged by LWSC is K 30/m^3 (USD 1.5/m^3) of septage. However, as there is no provision for measuring the volume being discharged, this fee is based on the capacity of the tanker. Therefore, a tanker with a capacity of 6 m^3 is charged a fixed K 180 (USD 9) when it comes to discharge regardless of the actual volume it is discharging. Similarly, a 10 m^3 tanker pays a fixed charge of K 300 (USD 15).

Generally, the emptying rate is very low. From the records available at the treatment plant, a maximum of seven truck loads per month were recorded for the period January to August 2022. Using the raw data provided on population that is on septic tanks and the size of the households, the total number of septic tanks in Kafue came to about 6,956. Assuming that a septic tank is supposed to be emptied once in three years, it is expected that about 2,319 septic tanks should be emptied every year. However, using the maximum number of truckloads to the plant on a monthly basis of seven and assuming one truck load is equivalent to one septic tank, the maximum emptying rate is 84 septic tanks per year translating to a maximum emptying rate of 3.6% (Table 3; Also refer to Appendix 1 for detailed data).

Table 3: Computation of the desludging rate based on available information.

Description	Quantity	Comment
Maximum Number of truck loads per month	7	Obtained from LWSC Data
Maximum emptying rate per year	84	Computed from maximum observed rate per month which was then multiplied by 12
Number of Septic Tanks in Kafue (No.)	6,956	Calculated from population on septic tanks and respective household size
Required emptying rate (Septic Tanks/Year)	2,319	Assumed emptying is required once every three years
Current desludging rate as a percentage	**3.6**	

From interviews with LWSC personnel, there are indications that the utility will soon embark on developing a faecal sludge management strategy for the town. This is important as it will obviously be preceded with studies that will generate data that will help fill in the data gaps that currently exist. It is also important that the practice of co-treating faecal sludge with the normal wastewater is avoided as this practice has the potential to upset the treatment processes in the existing plant which was not designed to handle septage and faecal sludge.

Containment: Based on the head-count data collected by MoH, about 60.9% of the population in Kafue depend on onsite sanitation as a means of excreta disposal. Of this population, 51.8% (31.6% of the total population) is serviced by septic tanks while 48.2% (29.3% of the total population) is serviced by pit latrines.

2.1.3 Open Defecation

While most of the population of Kafue are on onsite and offsite sanitation, about 1% are reported to be practising Open Defaecation (OD) as detailed in Appendix 1.

2.2 SFD Matrix

Table 4 shows the SFD matrix.

Table 4: SFD Matrix.

Kafue, Lusaka, Zambia, 18 Sep 2022. SFD Level: 1 - Initial SFD
Population: 92359
Proportion of tanks: septic tanks: 100%, fully lined tanks: 100%, lined, open bottom tanks: 100%

Containment						
System type	Population	WW transport	WW treatment	FS emptying	FS transport	FS treatment
	Pop	W4a	W5a	F3	F4	F5
System label and description	Proportion of population using this type of system (p)	Proportion of wastewater in sewer system, which is delivered to centralised treatment plants	Proportion of wastewater delivered to centralised treatment plants, which is treated	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated
T1A1C2 Toilet discharges directly to a centralised foul/separate sewer	38.1	48.1	74.0			
T1A2C5 Septic tank connected to soak pit	25.3			3.6	100.0	74.0
T1B11 C7 TO C9 Open defecation	1.0					
T1B7C10 Pit (all types), never emptied but abandoned when full and covered with soil, no outlet or overflow	20.5					
T2A2C5 Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	6.3			0.0	0.0	0.0
T2B7C10 Pit (all types), never emptied but abandoned when full and covered with soil, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	8.8					

2.2.1 Distribution of containment technologies

Based on the data that was collected from the field, distribution of containment technologies can be presented as summarised in Table 5.

Table 5: Distribution of containment systems for preparation of SFD graphic.

Containment Technologies	Total (%)	SFD Classification
Offsite Toilets discharging directly to a centralized foul/separate sewer	**38.1%**	T1A1C2
Onsite	**60.9%**	
Septic Tank Septic Tank Connected to soak pit, when there is a low risk of groundwater pollution.	25.3%	T1A2C5
Septic Tank Connected to soak pit, when there is a significant risk of groundwater pollution.	6.3%	T2A2C5
All types of Pit Latrines Never emptied but abandoned when they are full and covered with soil, no outlet or overflow, where there is a low risk of groundwater pollution	20.5%	T1B7C10
Never emptied but abandoned when they are full and covered with soil, no outlet or overflow, where there is a significant risk of groundwater pollution	8.8%	T2B7C10
Open Defecation	**1.0%**	T1B11C7 TO C9

Offsite

The only type of offsite sanitation system in Kafue is where toilets discharge directly to the centralized WWTP through a centralized sewer network. The coverage for this system is estimated at about 38%. It was estimated that only 48.1% of the wastewater is delivered to treatment (W4a = 48.1%) due to the available data on the amount of wastewater that goes directly into the environment because of the old sewer network and overflows that occur when the pumping stations are unmanned during night time.

Wastewater treatment efficiency was estimated at 74% (W5a = 74%), which is the percentage of adequately treated parameters that comply with the ZEMA Standards as stated in Table 3.

Septic tanks

Based on data collected from EHTs, which is summarised in Appendix 1, the population on septic tanks was estimated at 31.6% of the total population. This was calculated by disaggregating data on flushable toilets that included connections to both the sewer network and septic tanks. The process included adding all onsite sanitation facilities after which the number of pit latrines were subtracted from the total figure. The difference derived, was then taken as the proportion of the overall flushable toilets discharging into septic tanks. About 20% of these facilities were estimated to be in areas where there is a significant risk of groundwater pollution.

Pit latrines

In line with the information collected from MoH surveys, an estimated 29.3% of the population in Kafue use pit latrines. These are toilets that reported to have never been emptied but abandoned when they are full and covered with soil, with no outlet or overflow. About 30% of these were estimated to be in areas where there is a significant risk of groundwater pollution.

2.2.2 Emptying of onsite technologies

The emptying rate is very low and only septic tanks located in areas of low risk of groundwater contamination are emptied. From data on the maximum number of truck loads per month, the maximum emptying rate per year, the number of of septic tanks in the town and the required emptying rate (Table 3), the estimated desludging rate was calculated as 3.6% and thus, variable F3 for septic tanks (T1A2C5) was set to 3.6%. For septic tanks located in areas of high risk of groundwater contamination (T2A2C5), variables F3, F4 and F5 for these systems were all set to 0% since they have not been emptied.

2.2.3 Transport of FS from onsite technologies

It was estimated that 100% of emptied FS reaches treatment (variable F4 = 100%) since emptying of septic tanks is usually carried out by local formal emptying service providers and operators from Lusaka. The formal disposal point for emptied septage is the Chawama WWTP.

2.2.4 Treatment of FS from onsite technologies

Since all the FS sludge from septic tanks is co-treated with wastewater in the same WWTP (Chawama WWTP), the F5 value (the FS that is treated) is the same as that for wastewater and hence, variable F5 is set to 74%, which is the percentage of adequately treated parameters that comply with the ZEMA Standards as stated in Table 3.

Open Defecation: The available data from MoH shows that about 1% of the population practices OD as summarised in Appendix 1.

2.2.5 Risk of groundwater contamination

According to British Geological Survey (2001), inadequately constructed and poorly managed onsite systems often represent a significant hazard to groundwater because faecal matter accumulates in one place where leaching of contaminants into the subsurface environment may occur. A town like Kafue, with over 60% of onsite sanitation systems presents a situation that puts groundwater at high risk of contamination. Various literature argue that groundwater vulnerability occurs when faecal sludge and supernatant find their way into aquifer pathways and in the absence of this, groundwater vulnerability cannot be considered to exist. It was however, noted that a considerable number of households have hand-dug wells constructed especially in areas where water supply is erratic. This is especially the case in peri-urban areas where space is also limited. In some cases, plot sizes are small (e.g., about 300 m^2). This is too small to fit a hand-dug well and pit latrine in the same plot. This results in separation distances of less than 10 m in most cases. Even in the absence of detailed geological studies to establish unsaturated zones that stand as first line of natural defense against groundwater pollution, the proximity of water sources to sources of contaminants, can be used to discuss the risk of contamination.

Guidelines by the British Geological Survey of 2001 for assessing the risk to groundwater from onsite sanitation provides that in densely populated urban areas, it is doubtless safer to assume that groundwater is contaminated. The guidelines assume that considerable amount of excreta/wastewater is disposed of, ultimately wetting the unsaturated zone, thus leaching quickly into the water table. Furthermore, the existence of abandoned structures such as filled pit latrines which are not emptied provide contaminant pathways with the capacity to

compromise the unsaturated zones. However, since most of the areas in Kafue have piped water supply, the risk is mitigated. Overall, it was estimated that about 30% and 20% of the population on pit latrines and septic tanks, respectively, have facilities that result in exposure to the risk of groundwater pollution.

2.2.6 Data uncertainties

As mentioned above, there remains a lot of uncertainty with regard to the quantity of wastewater that reaches the treatment plant. No measuring devices exist at all the sewage pumping stations and the only measuring device within the treatment plant is dysfunctional (Figure 14). Therefore, the quantity of the wastewater that actually ends up at the WWTP had to be estimated.

Figure 14: Evidence on lack of flow measuring devices at the WWTP (LHS: A dysfunction Partial Flume meant to measure the effluent from the activated plant; RHS: The outlet from the Maturation ponds with no flow measuring device).

Further assessment on the proportion of pit latrines and septic tanks that are actually emptied is also not clear. There was also a challenge during data collection on disaggregation of flushable toilets that connect to the sewerage system and those discharging into septic tanks. There is need for a detailed survey on this aspect to ensure that data presented is reflective of what is on the ground.

There is also limited data on hydrogeological characteristics of Kafue town which is a key input factor in determining the vulnerability of groundwater. Other aspects like lateral separation between onsite facilities and water sources and reliance of the population on groundwater for water supply, which are also key in assessing groundwater vulnerability, are not clear. As such, the study relied on assumptions.

2.3 Summary of assumptions

Offsite sanitation systems:

- ✓ 38.1% of the population are connected to the sewer system. It was estimated that only 48.1% of the wastewater is delivered to treatment (W4a = 48.1%) out of which, 74% is treated (W5a = 74%).

Onsite sanitation systems:

- ✓ The proportion of Faecal Sludge (FS) in septic tanks was set to 100% and the proportion of FS in lined tanks with impermeable walls and open bottom and pits was set to 100%

according to the relative proportions of the systems in the municipality, as per the guidance given in the Frequently Asked Questions (FAQs) in the Sustainable Sanitation Alliance (SuSanA) website.

- ✓ Variable F3 for septic tanks (T1A2C5) was calculated as 3.6%. It is assumed that all FS emptied is delivered to treatment (F4 = 100%) and 74% of the FS delivered to treatment is treated (F5 = 74%).
- ✓ For septic tanks located in areas of high risk of groundwater contamination (T2A2C5), it was assumed that they have not been emptied, so variables F3, F4 and F5 for these systems were all set to 0%.

2.4 SFD Graphic

The SFD graphic for Kafue (Figure 15) shows that 41% of the population has their excreta unsafely managed while 59% has their excreta safely managed.

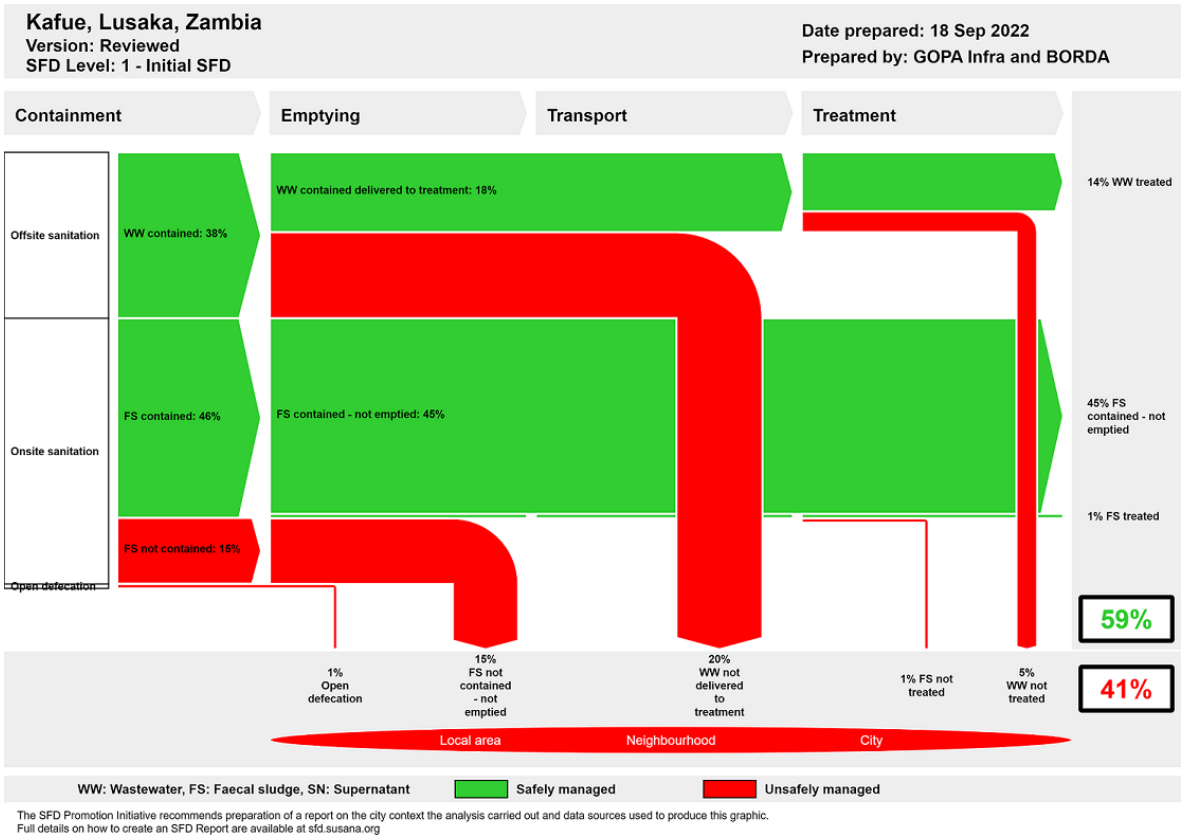

Figure 15: SFD Graphic for Kafue.

Most of the population (about 61%) is relying on onsite sanitation. The sewer network managed by LWSC currently only serves about 38% of the total population. It is not in a very good state, especially on the part of pumping stations some of which, due to various operational challenges, discharge directly into the environment. Because of this, only 48% of the wastewater from the population using offsite sanitation reaches the WWTP. Although the plant is not in a good state (i.e., the activated sludge plant has been on bypass the past two months and the maturation ponds are overgrown with weeds), 74% of the wastewater reaching the treatment plant gets adequately treated based on available quantitative data. This is mainly because the treatment plant is significantly both hydraulically and organically underloaded.

Thus, the SFD graphic shows that 20% is wastewater not delivered to treatment, 14% is wastewater treated and 5% is wastewater delivered to treatment but not treated.

For the 61% of the population relying on onsite sanitation, around three-quarters (45% of the total population), use a system where the FS is safely contained and not emptied. Either because when their pit becomes full it is abandoned, covered over and replaced, or because their septic tank has never been emptied. On the SFD graphic, these methods are considered safely managed (provided the tanks and pits are not causing a significant risk of polluting groundwater used for drinking). However, this should only be considered a temporary situation, as when the septic tanks become full they will require emptying and, if they are not emptied, they will overflow with a significant risk to public health.

A further very small proportion of the population (2%) use an OSS where the FS is delivered to treatment, of which 1% is treated and 1% is not treated.

Importantly, the balance (15% of the population) use a system in which the FS is not contained and not emptied. Either because the tank or pit does not safely contain the excreta, and/or is in a location where there is a significant risk of causing pollution of groundwater that is used for drinking.

Open defecation is estimated at 1%. Discussions with the utility staff supported this estimation, however, there is need to probe further to come up with a more accurate figure.

3 Service delivery context

3.1 Policy, legislation and regulation

The Government of the Republic of Zambia (GRZ) has put up a very clear policy, regulatory and legal frameworks for provision of water supply and sanitation services to create an enabling environment to attain universal access to sanitation for all by 2030. The sections below outline the policy, institutional/ regulatory and legal frameworks for sanitation which applies at both national and local levels.

3.1.1 Policy

The following policies and strategies have been put in place to provide direction and guidance on the vision to achieve the universal access to safely managed sanitation for all by 2030.

The Zambia Vision 2030: The vision identifies inadequate access to safe water supply and sanitation as one of the human well-being and social development aspect that needs to be improved for Zambia to attain the aspiration to become a prosperous middle-income country by 2030. In this regard, the vision sets target to improve access to adequate, appropriate and environmentally friendly sanitation for at least 90% of Zambians by 2030.

The 7th Development Plan 2017 – 2021: Outlines the intended five-year developmental outcomes and goals to achieve the vision 2030. Thus, the plan outlines strategies and programs that are aimed at improving access to safely managed sanitation at all levels in Zambia.

National Water Supply and Sanitation Policy of 2020: The policy was developed based on the vision 2030 and the Sustainable Development Goals (SDGs) and its implementation shall be through the National Development Plans. The policy sets clear and coherent policy measures that guide the improvement of access to adequate and safely managed sanitation for all. One of the objectives of the policy is to provide the legal and institutional framework for sanitation service delivery in Zambia.

National and Local Programs: The National Urban Water Supply and Sanitation Program (NUWSSP, 2011 – 2030) enables all urban residents, commerce, institutions and industry to have access to sanitation and utilize it in an efficient and sustainable manner for improved health, well-being and livelihood by 2030. Specifically, the National Urban and Peri-Urban Sanitation Strategy (NUSS, 2015- 2030) provides a framework for financing and implementing the sanitation component of the NUWSSP and has set a target to “provide adequate, safe and cost-effective sanitation services to 90 percent of the urban population by 2030”. To achieve this target, one of the objectives is to improve access to sanitation and safely manage sanitation systems so as to reduce the incidence of water borne diseases outbreaks such as cholera.

United Nations Sustainable Development Goals 2015 – 2030: Zambia is a member of the United Nations (UN) and all developmental programs and policy documents in the water supply and sanitation sector are aligned to the SDG No. 6 and its targets.

All these policy documents and programs have set clear objectives, targets and an enabling environment on sanitation service improvement for both urban, peri-urban and rural areas in the country. Kafue is a beneficiary of these initiatives and strategies.

3.1.2 Institutional roles

The Framework for Provision and Regulation of Urban Onsite Sanitation and Faecal Sludge Management and the Framework for Provision and regulation of Rural Water Supply and Sanitation in Zambia sets a robust institutional arrangement that clearly specifies the roles and responsibilities of all key players in the Water Supply and Sanitation Sector in Zambia. Figure 16 shows the institutional and regulatory framework and outlines the various roles and responsibilities of the key sector players in Zambia.

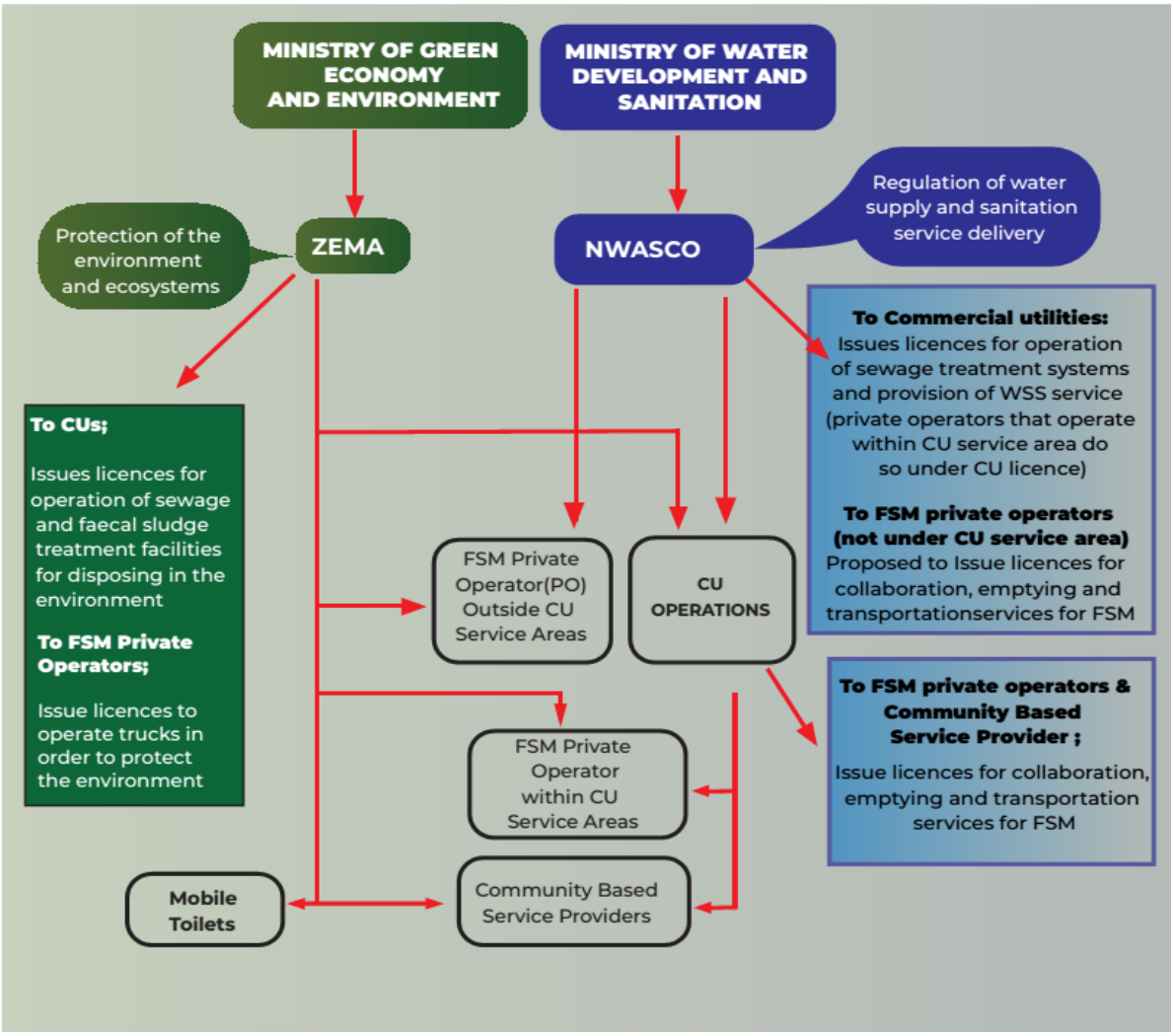

Figure 16: Regulatory Framework for Provision of Sanitation Services (Adapted from NWASCO, 2018).

At the local level, a number of key players exist. These are explained in the ensuing sections.

Kafue District City Council*:* Under the direction of Ministry of Local Government (MLG), Kafue District Council (KDC) focuses on the enforcement of Ministry of Health's Hygiene regulations and the development of by-laws on sanitation service provision through the Public Health Departments. KDC also holds some shares in LWSC and sits on the board as well as delegates' LWSC for water supply service and sanitation provision as per the WSS act No. 28 of 1997. KDC, through Environmental Health Officers and Health Inspectors, are mandated to

enforce and regulate the sanitation relevant laws related to the Public Health Act (Drainage and Latrine), Regulation 1994 (Amended 2006) related to collection, transportation and treatment of wastewater. KDC also has a mandate for other services that relate to the quality of the urban environment and therefore have a broader responsibility for sanitation that also includes solid waste management and storm-water drainage system for areas within the town of Kafue.

KDC also issues business levy licenses to all businesses operating in the city including service providers in solid and liquid waste management. However, very little is happening when it comes to registration of businesses providing OSS and FSM services in the city as these are not yet well established.

Lusaka Water Supply and Sanitation Company (LWSC): LWSC is the commercial Utility delegated by KDC to provide water supply and adequate sanitation services to rural, urban and informal areas of Kafue District and with the other five being Lusaka, Chilanga, Chirundu, Chongwe and Luangwa districts. LWSC is overseen and regulated by the National Water Supply and Sanitation Council (NWASCO) and manages the current water supply and sanitation infrastructure for the town.

National Water Supply and Sanitation Council (NWASCO): According to the Framework for Provision and Regulation of Urban Onsite Sanitation and Faecal Sludge Management, regulation of sanitation service provision (including OSS and FSM) in Kafue Town is done through new licensing conditions of 2018 issued to LWSC by NWASCO. Under the licensing conditions, any private operator providing sanitation services (e.g., emptying of OSS facilities) within the LWSC's designated service area will do so under a delegated management contract with LWSC. Private operators providing services outside the service areas of LWSC need to obtain a permit directly from NWASCO (NWASCO, 2018).

Zambia Environmental Management Agency (ZEMA): ZEMA is responsible for applying the legal framework for the protection of the environment and the control of pollution. Under the Environmental Management Act, no 12 of 2011, ZEMA regulates discharges into the environment and promotes water pollution monitoring and prevention programs based on enforceable water quality guidelines and standards. ZEMA is also responsible for issuance and enforcement of waste management licenses to any individual or entity who wishes to collect and transport domestic and commercial waste in the city for environmental protection.

3.1.3 Standards

Several laws and regulatory tools exist which provide a clear legal framework for sanitation at both national and local level. These include the following:

The Water Supply and Sanitation Act No. 28 of 1997: Mandates NWASCO to regulate water supply and sanitation provision in urban, peri-urban and rural areas as well as provides for the formulation of utility companies who are responsible for water supply and sanitation service provision.

Local Government Chapter 281, Volume 16 of the Laws of Zambia: Mandates Local Authorities (LAs) for provision of water supply and sanitation services in the respective districts. Service provision is delegated to the utility companies who are owned by the LAs.

The Public Health Act Chapter 295, Volume 17 of the Laws of Zambia: Mandates LAs to enforce public health protection.

The Environmental Management Act No. 12 of 2011: Mandates ZEMA to license, regulate and enforce environmental safeguards which includes treated wastewater effluent discharge standards

Water Resources Management Act of 2011: Establishes WARMA to set, regulate and enforce standards on surface and ground water quality which are often receiving bodies of treated effluent. It further prescribes the minimum distances for structures including onsite sanitation facilities from natural water resources.

The Statutory Instrument No. 112 of 2013: Sets limits and standards for environmental protection including licensing of vehicles for transportation of faecal sludge and treatment facilities.

Statutory Instrument No. 100 of 2011: Provides for LAs to manage solid waste in the areas of operation. Poorly managed solid waste systems lead to indiscriminate disposed of municipal waste into onsite sanitation facilities, making emptying services challenging.

4 Stakeholder Engagement

Stakeholders that were engaged at inception included LWSC personnel from both headquarters and Kafue District Offices. This was done with the aim of getting a clear understanding of the sanitation infrastructure status from the perspective of utility personnel. Engagement with these experts was through KIIs. Other staff from the utility that were engaged included operators in charge of the various sanitation facilities (i.e., the SPSs and the WWTP). Engagement here was through a combination of interviews and observations.

Other stakeholders included staff from the MoH. The MoH, through EHTs, were critical to providing data on sanitation facilities within their defined catchment areas. These catchment areas provided a basis for establishing important delimitations for obtaining sanitation coverage that served to develop the SFD graphic. Consultations here were again through interviews.

5 Acknowledgements

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-Ten KIIs to stakeholders from the LWSC and MoH conducted in 2022 (further information in Appendix 3.

7 Appendix

7.1 Appendix 1: Summary of Population and Type of Sanitation in Kafue Town Based on MoH Zones

AREA	DEMOGRAPHY			POPULATION ON THE DIFFERENT SANITATION TYPES			POP. ON THE VARIOUS SANITATION FACILITIES			NUMBER OF FACILITIES	
Zone	Population	Households	Persons per HH	Onsite	Offsite	Open Defecation	Septic Tanks	Pit Latrines	Open Defecati	Septic	Total Latrines
Nangongwe	2,754	550	5	0	2,754	0	-	-	-	0	0
Kaseba	4,900	1,450	3	95	4,805	0	- 0	95	-	0	28
Chawama	2,294	442	5	1,402	892	0	48	1,355	-	9	261
Lumumba A & B	12,717	2,415	5	11,510	518	689	3,701	7,809	-	703	1483
Nangongwe Site & Service	1,521	176	9	1,521	0	0	1,383	138	-	160	16
Kasengele	4,791	920	5	4,168	623	0	68	4,100	-	14	820
Kashelela	5,433	1,113	5	4,984	435	14	444	4,540	-	91	930
Mutendere	3,801	660	6	3,691	109	1	368	3,323	-	64	577
Kalundu View	1,529	537	3	1,450	28	51	368	1,082	-	129	380
Kafue Town	4,055	495	8	218	3,837	0	22	197	-	3	24
CCF (Children Child Fund)	6,442	1,197	5	6,442	0	0	6,442	-	-	1197	0
Whilrpool	2,577	1,541	2	2,577	0	0	2,577	-	-	1541	0
UCZ	3,866	1,164	3	3,866	0	0	3,866	-	-	1164	0
Estates C5	7,958	2,211	4	11	7,947	0	3	7	-	1	2
Estates C6	6,821	869	8	149	6,672	0	7	141	-	1	18
Estates C7	4,547	998	5	66	4,481	0	3	64	-	1	14
Soloboni	3,411	1,625	2	2,927	484	0	348	2,580	-	166	1229
Zone 7	2,964	518	6	2,950	0	14	2,630	320	-	460	56
Zone 8	1,517	258	6	1,463	0	54	1,392	71	-	237	12
Zone 9	2,521	471	5	2,495	0	26	2,222	273	-	415	51
Zone 10	4,003	730	5	3,902	0	101	3,228	674	-	589	123
Kafue East	1,937	499	4	393	1,544	0	57	336		14	84
TOTALS (No.)	**92,359**	**20,839**		**56,280**	**35,129**	**950**	**29,176**	**27,104**		**6,957**	**6,108**
TOTALS (%)				**60.9**	**38.0**	**1.0**	**31.6**	**29.3**			

7.2 Appendix 2: Summary of calculations on percentage of wastewater that is not safely collected

AREA	DEMOGRAPHY	POPULATION ON THE DIFFERENT SANITATION TYPES		DISCHARGE POINT
Zone	Population	Onsite	Offsite	Point of Discharge
Nangongwe	2,754	0	2,754	Direct to Chawama WWTP
Kaseba	4,900	95	4,805	Direct to Chawama WWTP
Chawama	2,294	1,402	892	Direct to Chawama WWTP
Lumumba A & B	12,717	11,510	518	To point before PS 03
Kasengele	4,791	4,168	623	To point before PS 03
Kashelela	5,433	4,984	435	To point before PS 03
Mutendere	3,801	3,691	109	To point before PS 03
Kalundu View	1,529	1,450	28	To point before PS 03
Kafue Town	4,055	218	3,837	To point before PS 03
Estates C5	7,958	11	7,947	Direct into Environment
Estates C6	6,821	149	6,672	Direct into Environment
Estates C7	4,547	66	4,481	To point before PS 03
Soloboni	3,411	2,927	484	To point before PS 03
Kafue East	1,937	393	1,544	To point before PS 03
Total Offsite	35,129			
Less C5 and 6	14,620			
Direct Disrcharge to Plant	8,451			
Total to SP 03	12,058			
From around 20 hours to 05 hours, PS 03 discharges directly into the environment. Considering that this period is off peak we assume a factr of 0.3 for total from PS 03 into the Environment.				
Therefore, PS 03 to Environment=	3,617			
Total to Environment	18,237			
Percentage of not safely collected (%)	**51.9**			

7.3 Appendix 3: Stakeholder identification

Name of Organization	Name of Contact Person	Position	Influence (High/Medium/ Low)	Interest (High/Medium/ Low)
LWSC	Mwiche Seleketi	High	High	High
LWSC	Philemon Masangula	Head, M&E	High	High
LWSC	Kango Mwanza	Station Manager	High	Medium
LWSC	Mabvuto Zulu	Acting Engineer	High	High
MoH	Kareen Kachenga	Environmental Health Technologist – Nangongwe Catchment	High	Medium
MoH	Mwale Grayson	Environmental Health Technologist – Railway Catchment	High	Medium
MoH	Zillan Mwiya	Environmental Health Technologist - Shikoswe	High	Medium
MoH	Audrey Nyirongo	Environmental Health Technologist- Estates Catchment	High	Medium
MoH	Justina Phiri	Environmental Health Technologist – Mutendere Catchment	High	Medium
--	Bob Chivwindi	Environmental Health Technologist – Kafue East Catchment	High	Medium

7.4 Appendix 4: Tracking of Engagement

Stakeholders Engaged	Date of Engagement	Purpose of Engagement
LWSC staff working in the Corporate Planning and M&E department.	07.02.2022 to 08.02.2022	Agreement on town boundaries and map for Kafue district.
LWSC staff – Station Manager	08.02.2022	Background information on water supply and sanitation in Kafue
LWSC staff – Focal Point Persons	2.02.2022 to 10.02.2022	Agreement on population figures, extent of the water network and Sewer network Agreement on city boundaries Definition of water and sewerage networks
Ministry of Health – Kafue	10.02.2022 to 01.03.2022	Information on sanitation coverage and total population for Kafue

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