SFD Report

Kitwe
Zambia

Final Report

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

Date of production: 16/07/2022

Last update: 12/04/2023

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SFD Report Kitwe, Zambia, 2023

Produced by: GOPA Infra GmbH and BORDA Zambia on behalf of the GIZ Reform of the Water Sector Programme Phase II

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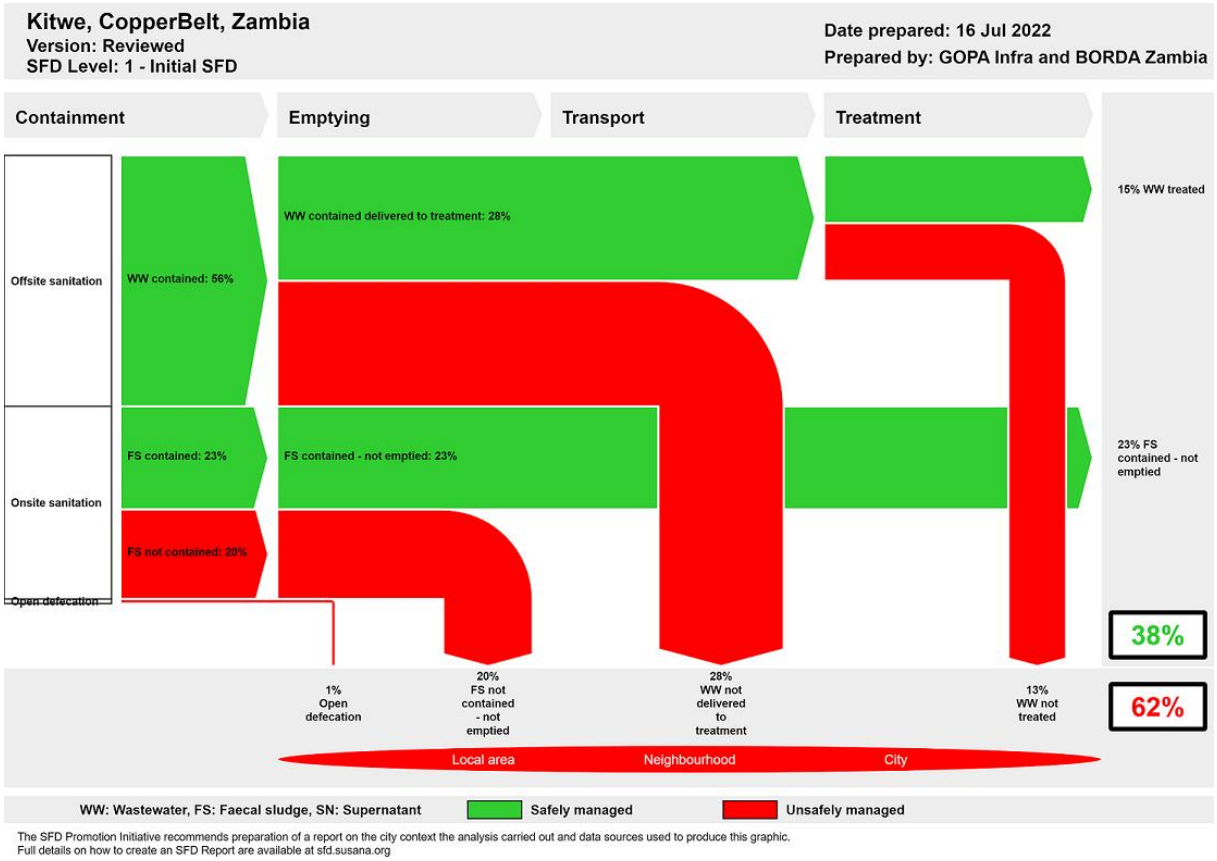
1. The SFD Graphic



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:

This SFD report was produced by GOPA Infra and BORDA Zambia on behalf of the GIZ Reform of the Water Sector Programme Phase II.

Collaborating partners:

- GIZ Zambia Water and Energy Cluster
- Nkana Water Supply and Sanitation Company Limited (NWSC)
- Kitwe City Council (KCC)

Status:

Final Initial level SFD Report.

Date of Production: 16/07/2022

3. General city information

Kitwe is one of the major mining cities in Zambia. The city is on the central part of the Copperbelt Province and is the third largest city in Zambia after the Capital Lusaka and the Provincial Capital Ndola.

The city covers an estimated 815.76 km^2. Demographically, it is also the second most populated city after Lusaka. According to the 2010 census, Kitwe had a population of 517,543 with a projected annual growth rate of 3.2 percent. In 2021, the projected population of the city was at 757,530 with a population density of approximately 928.61 people/ km^2.

Most of the population in Kitwe resides in low income and peri-urban areas (PUAs). These areas are characterised with low access to adequately managed water supply and sanitation services.

Kitwe experiences annual average temperature ranges of between 9ºC and 31ºC. The average annual rainfall for Kitwe is 1,258 mm and the majority of precipitation occurs during the months of December to March.

Copper Mining is the main employer (as mine workers) of the city and has greatly influenced

the city's economic set-up and growth (UN-HABITAT, 2009).

4. Service outcomes

There is almost an equal proportion of people in the city using onsite and offsite sanitation systems. The population on offsite sanitation are connected to the sewer network managed by Nkana Water Supply and Sanitation Company (NWSC) which currently covers about 56% of the population. The sewer network is not in a good state to convey all the collected wastewater to its designated treatment plants. Only about 28% of the city population has its sewage or wastewater reaching the treatment facilities out of which only 15% is said to be safely treated.

On the other hand, 43% of population relies on Onsite Sanitation System (OSS) facilities such as septic tanks and pit latrines. Of the total faecal sludge accumulated in OSS containments, only 23% of the population has their faecal sludge safely contained onsite. However, the generated and contained faecal sludge does not get emptied and hence does not reach treatment plants due to the lack of emptying and transportation services in the city. Nonetheless most of the contained faecal sludge in OSS facilities is assumed to be safely managed as the facilities are in areas with a low groundwater contamination risk and the majority of the residents reported safely abandoning their pits when full and construct new ones (Sanitation Mapping, 2018).

On the other hand, and as shown in the SFD graphic, 20% of population using OSS system have their faecal sludge or excreta not safely contained onsite. The reasons are due to the lack of adequate emptying and transportation services in the district, poorly constructed containment systems and, overflowing or damaged facilities (common during the rainy season) which drain directly into the environment. It remains somewhat unclear what happens to all the sanitation facilities that are either not emptied or abandoned when full.

Open defecation in the city is estimated at 1%. An estimation that was arrived at after discussions with utility staff supported the estimation. However, there is need to probe further to come up with a more accurate figure.

About a third of Kitwe City (residing mostly on the western side of the district) is in an area that is assumed to be vulnerable to groundwater contamination due to its hydrogeological formation and features. It was estimated that 25% of the population who rely on OSS systems (especially pit latrines) reside in this area which can be considered as vulnerable to groundwater contamination. This is backed-up by the findings from two studies conducted in two residential areas within Kitwe District which reported incidences of groundwater contamination with faecal matter (Nyirenda, et.al. 2016; Siwila and Buumba, 2021). The population in this area also significantly relies on groundwater sources.

Overall, the SFD graphic shows that 62% of the population has their excreta unsafely managed while 38% has their excreta safely managed.

However, the safely managed sanitation from the population using onsite sanitation (23% FS contained – not emptied) is all from tanks and pits that have not been emptied. For the population using septic tanks, this should be considered a temporary situation as when these tanks become full, they will require emptying. If they are not emptied, they will overflow resulting in a significant public health risk.

5. Service delivery context

To guide the vision to achieve universal access to sanitation by 2030, the Government Republic of Zambia (GRZ) has put up a very clear policy, regulatory and legal framework for water supply and sanitation services. Important sanitation and environmental protection policies that have been put in place and are used 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 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 Kitwe Town. 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).
- Kitwe City Council (KCC).
- Water Resources Management Authority (WARMA).

- NWSC.
- Private Service Providers, 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 who are responsible for water supply and sanitation service provision.
- Local Government Act Chapter 281, Volume 16 of the Laws of Zambia of 2019: Mandates local authorities 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 local authorities 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 and mandates WARMA to set, regulate and enforce standards on surface and groundwater 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 local authorities 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

The Urban Onsite Sanitation and Faecal Sludge Management – Framework for Provision and Regulation in Zambia which was launched by NWASCO in 2018 creates an enabling environment for sanitation service provision including OSS and Faecal Sludge Management (FSM). The framework clearly defines the roles and responsibilities of all the key stakeholders as illustrated in the Table 1.

Table 1: Key Actors in Urban Onsite Sanitation (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)
	KCC	Enforcement of sanitation systems and public health standards.
Service Providers	NWSC	Sanitation service provision to rural, urban and PUAs
	Private Operator	Emptying and transportation/ O&M of treatment facilities under a delegated management arrangement with NWSC.
Customer	Households, Commercial and Public institutions.	Responsible for investment in OSS 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, KCC, WARMA, NWASCO, NWSC and MWDS to effectively manage sanitation services.

7. Process of SFD development

The SFD graphic was developed in consultation with key NWSC staff. The sanitation mapping exercise conducted by NWSC in 2021 was also instrumental in the production of the SFD graphic. Data gaps that were identified from the analysis of the sanitation mapping data were filled through detailed desk reviews of the recently published literature on the state of sanitation systems in Kitwe District. Further, information was gathered through field visits to treatment facilities and other sanitation infrastructure in the city which is managed by the utility.

Other secondary data sources such as the Africa Groundwater Atlas Country Hydrogeology Maps were used to determine the risk of groundwater contamination by faecal matter that is posed by containment systems in relation to their conditions and quality of construction.

All assumptions made during the SFD graphic development where initially presented and discussed with NWSC staff. The feedback gotten from the stakeholders was used to revise the SFD graphic to ensure it is in line with the situation on the ground.

8. Credibility of data

The quality of the data that was used to produce the SFD graphic is of high quality. The major source of the information was the sanitation mapping exercise data that was done in 2021. Further discussions were held with various NWSC utility staff to validate sanitation mapping information and also fill in some of the identified gaps e.g., the sanitation mapping did not capture the number of people without access to sanitation facilities. The information retrieved from the mapping data included:

- Types of mapped sanitation facilities and their containment systems (total numbers).
- Population using each type of containment system.
- Conditions of containment systems (to determine if sludge is safely contained); and
- Action taken when containment gets full.

The following were the major data gaps:

- There was no information on the number of people without access to a sanitation facility (i.e., the Sanitation Mapping did not capture this information);
- There was no clear indication and information on the number of people practising Open Defecation (OD). Through consultations with the utility staff, 1% OD was assumed;
- There was no information on the activities of informal or illegal pit emptiers operating in Kitwe District (it was assumed 23% of all pit latrines facilities that fill up are safely abandoned and the rest of the faecal sludge ends up in the environment); and
- There was inadequate data on the performance of treatment plants and volumes of wastewater that are safely treated (treatment efficiency was assumed based on the effluent quality data generated by NWSC as well as reports on the state of the sewerage infrastructure in the city).

9. List of data sources

The following data sources were consulted in producing this executive summary:

- NWSC. 2021. Kitwe Sanitation Mapping GIS Toilet Database.
- Nyirenda, et.al. 2016. 'Spatial Distribution of Groundwater Quality in Kitwe District, Copperbelt Province, Zambia: A Case study of Mulenga Informal Settlement', American Journal of Water Resources,
- NWSC. 2021. Statutory Returns Jan to Dec 2021.pdf
- O Dochartaigh, B. E. 2019. 'User Guide: Africa groundwater atlas country hydrogeology maps, version 1.1'.
- SMEC International. 2021 'REPORT KIT-S-2.2 - Interim Detail Design Review Report (Kitwe Sewer Treatment works)'.
- SMEC International. 2021. 'REPORT KIT-S-2.2 - Interim Detail Design Review Report (Kitwe Bulk Sewer and Sewer Network).'
- Siwila, S. and Buumba, C. 2021. 'Investigation of groundwater contamination in relation to septic systems in Kitwe West Township, Kitwe, Zambia', Water Science and Technology
- UN-HABITAT. 2009 Zambia: Kitwe Urban Profile.

SFD Kitwe, Zambia, 2022

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Abbreviations

AfDB	African Development Bank
BMZ	German Federal Ministry of Economic Cooperation and Development
BORDA	Bremen Overseas Research Development Agency
CU	Commercial Utility
FSM	Faecal Sludge Management
FSTP	Faecal Sludge Treatment Plant
GIS	Geographical Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit, GmbH
GRZ	Government of the Republic of Zambia
KII	Key Informant Interview
KCC	Kitwe City Council
LICs	Low-income Community
MLG	Ministry of Local Government
MoH	Ministry of Health
MWDS	Ministry of Water Development and Sanitation
NE	Nkana East
NUSS	National Urban and Peri-Urban Sanitation Strategy
NUWSSP	The National Urban Water Supply and Sanitation Program
NWSC	Nkana Water Supply and Sanitation Company
NWSSPI	Nkana Water Supply and Sanitation Project Phase I
NWSSPII	Nkana Water Supply and Sanitation Project Phase II
NWASCO	National Water Supply and Sanitation Council
OSS	Onsite Sanitation System
PUA	Peri-Urban Area
SFD	Shift -Flow Diagram
SDGs	Sustainable Development Goals
UN	United Nations
WARMA	Water Resources Management Agency
WSS	Water Supply and Sanitation
ZEMA	Zambia Environmental Management Agency

1 City context

Kitwe City is one of the major mining cities in Zambia and is located on the central part of the Copperbelt Province, being the third largest city in Zambia after Lusaka and Ndola. The geographical extent for the area of focus for the SFD graphic is shown in Figure 1 and is based on the boundaries for the townships/ wards in the urban part of Kitwe District and are aligned to the service area for Nkana Water Supply and Sanitation (NWSC) - the mandated utility to provide water supply and sanitation services in the district.

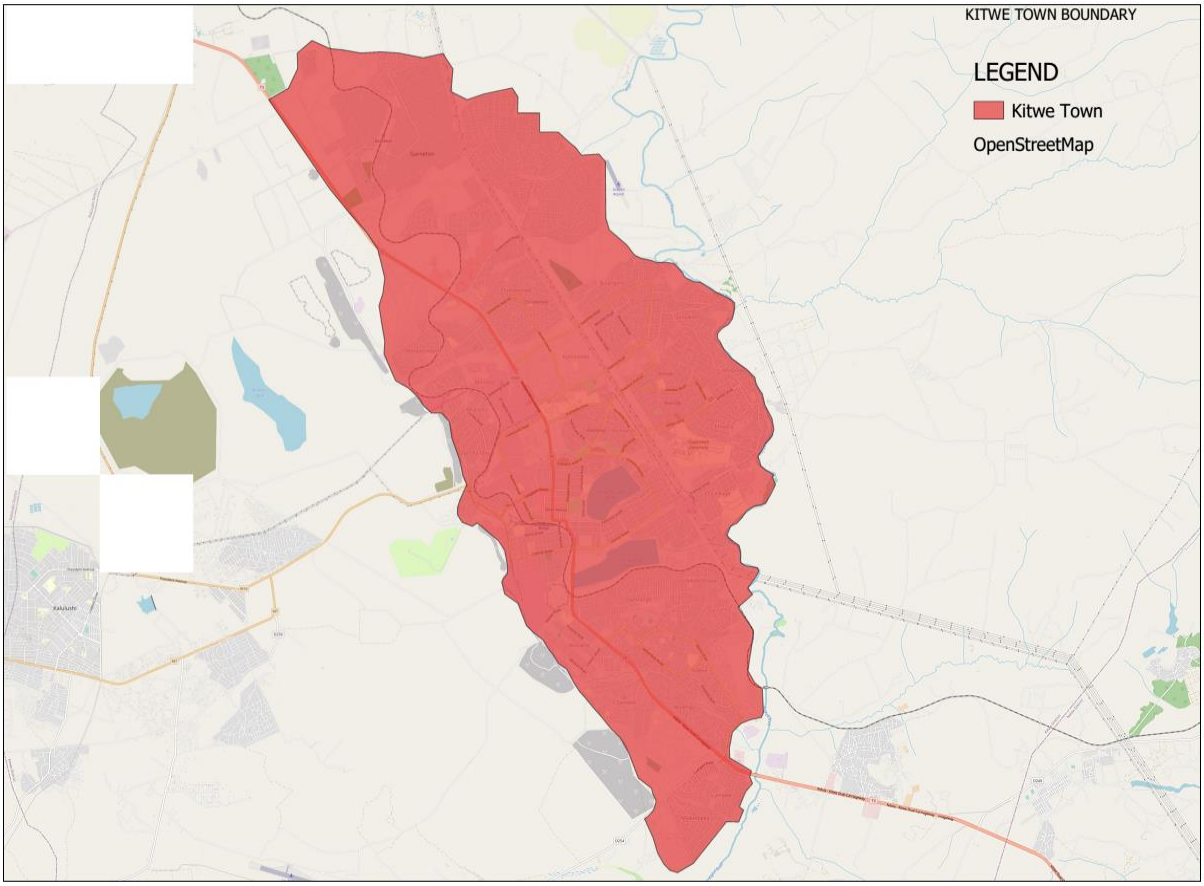

Figure 1: Kitwe District Map Showing the Administrative Ward Boundaries (Source: NWSC, 2022).

1.1 Climate

Kitwe's weather is characterized by four seasons:

- The cool dry winter season running from June to August;
- The dry, warmer and more humid pre-rainy season from August to October;
- The wet humid warm season from November to March; and
- The post rainy season from April to May.

Falling within the Copperbelt Province weather conditions, Kitwe experiences annual average temperature ranges of between 9ºC and 31ºC. The lowest average temperature of 9ºC is recorded in July and the highest average temperature of 31ºC is recorded in October. According to the Zambia Meteorological Department, the average annual rainfall for Kitwe is 1,258 mm and the majority of precipitation occurs during the months of December to March. The driest month for the city is October.

The topography for the city is generally flat and the hydrogeology is mainly comprised of the upper Roan dolomite aquifer (a consolidated sedimentary aquifer with fracture flow) and the basement complex (an undifferentiated and granite aquifer). The water table of the upper Roan aquifer is generally 20 to 35 m below the ground surface and it is characterized as highly productive. However, the southern westerly parts of the city which are near the Kafue River have a shallow lying groundwater aquifer (i.e., high groundwater table) and experience seasonal flooding. The high-water table is also seen through the high prevalence of shallow hand dug wells in most of the low-income settlements. Most of the households in the densely populated unplanned settlements rely on shallow wells as alternative sources of water for domestic use since water supply by the municipality in some of these areas is mostly through communal stand taps and kiosks on erratic supply.

Mining is the central economic activity in the district and the source of employment for most city residents who mostly are mine workers (UN-HABITAT, 2009). It has greatly influenced Kitwe's economic set-up and growth. However, over the years, small scale trading and manufacturing have also become a main source of employment besides the mines.

1.2 Population

According to UN-HABITAT (2009), Kitwe is the third largest city in Zambia (after Lusaka and Ndola) and the most populated city on the Copperbelt Province and the second most populated city in Zambia after the capital Lusaka. According to the census on population and housing of 2010, Kitwe had a total population of 757,530 with an annual population growth rate of 3% (CSO, 2011). In 2021, the central statistics population projected the city population to have grown to 716,401 people. There is rapid population growth in the city due to rapid urbanization and most of the population resides in low income and peri-urban areas (PUAs) characterized with low access to adequately managed water supply and sanitation services (UN-HABITAT, 2009). In addition, a transient population from the surrounding towns (e.g., Mufulira, Kalulushi and Chambishi) and the agricultural areas pushes the daytime population up. However, there are no official estimates of this transient population, but it is estimated that it pushes the city's population past 1.2 million during daytime (UN-HABITAT, 2009).

The urban part of the district covers an estimated area of 815.76 km^2, with a 2021 population density of approximately 928.61 people/ km^2. However, the population density in the informal and low-income areas can be as high as 16,000 people/ km^2. Generally, the north, central and southern parts of the city are more densely populated as compared to the greater western and eastern parts of the district that are mostly characterized by sparsely populated semi-rural areas and farmland.

2 Service Outcomes

2.1 Overview

Figure 2 shows the SFD selection grid that was generated for the development of the Kitwe City SFD graphic.

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					T2A4C10 Low risk of GW pollution
Lined pit with semi-permeable walls and open bottom	Not Applicable									T2A5C10 T1A5C10
Unlined pit										T2A6C10 T1A6C10
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										T1B9 C1 TO C10
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.

The SFD graphic for Kitwe City was developed based on primary sanitation data collected through a partial sanitation mapping exercise that was conducted in selected parts of Kitwe in the second quarter of 2021. The sanitation mapping data comprised a census of all sanitation facilities and their attributes in the selected areas. This mapping exercise was only conducted in some parts of the city which are serviced by the utility and included Wusakile, Chamboli, Parklands, Kwacha and Bulangililo. Although it only concentrated on a few areas, it still gives a good starting point as an initial baseline of sanitation data especially in terms of the different sanitation systems that are present as well as prevalent in the district.

The sanitation mapping data was also triangulated with the data that were collected during the customer perception index survey for NWSC which was also conducted in 2021. The mapping was conducted with the aim of trying to develop a sanitation database for the district as a first step to enhance sanitation reporting as well as inform the design of sanitation interventions.

Data from these surveys formed the major backbone upon which the Kitwe SFD graphic was developed. For areas that were not covered in these surveys, data were collected through field and desk-based assessments of the sanitation situation in the city. Data collection methods

included in-depth interviews, field observations, inspection of sanitation infrastructure and review of relevant secondary data sources. The compiled information from the sanitation database was validated through Key Informant Interviews (KIIs), discussions with NWSC Geographical Information System (GIS) staff and commercial and sanitation departments staff. The final validation was done through a workshop the utility hosted with various stakeholders in the city of Kitwe such as Kitwe City Council (KCC) planning staff and Ministry of Health (MoH) staff. The final validation was conducted to verify the initially collected data in the surveys.

2.1.1 Offsite sanitation

Sewer Network

Based on the results of the sanitation mapping exercise, offsite sanitation serves the majority of residents. For the areas that were considered in the survey (i.e., Wusakile, Chamboli, Parklands, Kwacha and Bulangililo) an estimated 77.3% of respondents indicated that they are on offsite sanitation system. However, when the other areas that were not considered in the survey are also included, the city's population on offsite sanitation reduces to 56%. It should be noted that the high coverage reported in the Sanitation Mapping Survey was because the areas considered are areas which are mostly serviced by reticulated sewerage systems, hence the percentage of the population reported to be connected to the sewerage network appeared to be higher than when all areas in the city are considered. Moreover, the statistics generated in the survey were based on responses from respondents giving the possibility for one who is on a septic tank to erroneously report it as sewered. However, the development of the SFD graphic considered all areas within the city and this approach yielded a sewerage connection rate of approximately 56%.

The offsite sanitation system in Kitwe City comprises a network of sewer pipes which convey wastewater to three centralized Wastewater Treatment Plants (WWTPs). All the sewer infrastructure in the city is operated and managed by NWSC. The sewer network in the city covers most of the old areas of city which are divided into three sewer sheds (i.e., Kitwe north, central and south) as depicted in Figure 4.

Generally, the sewerage infrastructure is old and in a dilapidated state as it has not received adequate maintenance and investments since its construction. During the site visits, it was observed that two major bulk sewer lines which transport sewage from two major sewer catchment areas has collapsed and has remained in this state for number years without being maintained. Thus, the wastewater generated and collected by this line ends up in the nearby stream (Figure 3). Sewage leakages due to blockages in the lines including missing manhole covers were frequently observed during the field observations and inspections.

Figure 3: Collapsed sewer trunk main and wastewater ending up in the environment (Source: Author, 2022).

Wastewater Treatment Systems

There are three WWTPs in Kitwe comprising one conventional wastewater treatment plant (Nkana East) and two sets of wastewater stabilization ponds (Ndeke Ponds and the Mindolo Ponds which are also known as Bulangililo Ponds) all of which are operated and managed by NWSC. The Nkana East WWTP services Kitwe Central while the Bulangililo (Mindolo) and Ndeke ponds service Kitwe North and Kitwe South, respectively (Figure 4).

Figure 4: Location of Treatment Plants (Source: SMEC, 2021).

The treatment plants have different capacities and are in different conditions. Table 1 gives an overview of the available treatment plants, their capacities and the condition in which they currently are.

Table 1: Overview of the Status of Treatment Plants in Kitwe (Source: Author, 2022).

Treatment Plant	Sewer Shed	Design Capacity	Water Body Discharges to	Condition
Nkana East WWTP (activated sludge system)	Kitwe Central	45ML/day	Kafue River	• The primary and secondary aeration tanks have six surface aerators respectively but only two are operational per tank. • Treatment efficiency in terms of organic matter removal is estimated to be between 30 – 40% due to non-functional aerators and short hydraulic retention time in the aeration basins (SMEC, 2021). There is no biological nitrate removal. • All the aerobic sludge treatment units are not operational; thus, no sludge treatment takes place at the plant. • A larger portion of the flow is bypassed and discharged into the Kafue River directly due to non-functional mechanical screens and detritor.
Mindolo/Bulangililo SP	Kitwe North	22.5ML/day (much of the flow is currently bypassed to Nkana East WWTP)	Kafue River	• The design capacity of the plant is underutilized as the majority of the flow is by-passed to Nkana East WWTP. • Treatment efficiency in terms of organic matter removal is estimated to be between 50 – 60% (SMEC, 2021).
Ndeke SP	Kitwe South	15ML/day	Kafue River	• The ponds are in a good state and operational. • Treatment efficiency in terms of organic matter removal is estimated to be between 50 – 60% (SMEC, 2021).

All treatment plants do not have flow measuring devices, thus the actual flows received at the plants are not measured. SMEC (2021) estimated the actual volumes for wastewater received at the treatment plants as follows:

1. NE WWTP – 50.2 ML/day (against a design capacity of 45ML/day);
2. Mindolo/Bulangililo SP – 23.3ML/day (against a design capacity of 22.5ML/day); and
3. Ndeke SP – 10.97ML/day (against a design capacity of 15ML/day).

Thus, all the treatment facilities are currently operating over capacity apart from the Ndeke ponds. However, at the time of the survey, most of the wastewater that flows to the Mindolo/Bulangililo ponds was being bypassed via a gravity sewer line to the Nkana East WWTP resulting in very low flows to these ponds and stressing the Nkana east WWTP. Due to this and other factors such as the non-functional screens and detritors, about half of the total wastewater that is received at the Nkana East plant is bypassed and discharged untreated into the Kafue River.

Generally, most of the physical and chemical parameters that are tested are within the acceptable Zambia Environmental Management Agency (ZEMA) effluent standards except for turbidity and ammonia which are sometimes out of range. Bacteriological parameters (i.e., *total* and *faecal coliforms*) are also out of range occasionally. There is no data on the efficiency of the sludge treatment but since the aerobic digesters are currently non-functional, it can be assumed to be very limited.

2.1.2 Onsite Sanitation

Containment Systems

Most of the residents in Kitwe District reside in PUA and low-cost areas where there are no reticulated sewer networks and therefore, they rely on Onsite Sanitation Systems (OSS) such as pit latrines and septic tanks for their sanitation needs.

Table 2 describes the common types of containment systems found in Kitwe and their conditions based on the information collected during the sanitation mapping exercise.

Table 2: Types of Containment Systems Commonly Found in Kitwe District (Source: Sanitation Mapping Data, 2021).

S/N	Type of containment	Comments
1	Lined Pits	• Average pit depth of 2.5m, usually rectangular shaped with an average width of 1.5m and length of 2m. • The majority of these containment systems (estimated at 73%) are said to be in a good condition.
2	Unlined Pit	• Average pit depth of 2.5m, usually square shaped with an average width of 1.9m and length of 2m. • The majority of these containment systems (estimated at 74%) are said to be in a good condition. The remainder need repairs and with about 3% needing construction of new containment systems.
3	Conservancy Tank/ leach Pit	• Average pit depth of 2.8m, usually with an irregular/ unknown shape. • The majority of these containment systems (estimated at 87%) are said to be in a good condition. The remainder need repairs/ rehabilitations due to cracks, missing manholes covers and blocked pipes.
4	Septic tank and Soak-away	• Average pit depth of 2.7m, usually rectangular shaped with an average width of 2m and length of 2.5m. • The majority of these containment systems (estimated at 84%) are said to be in a good condition. The remainder need repairs/ rehabilitations due to cracks, missing manholes covers and blocked pipes.

Generally, the containment systems have an average depth in the range of 2.5 – 2.8m. Most of these containment systems were reported to be in stable/ good condition. However, the lack of design and construction standards for sanitation facilities, coupled with the non-existence of

trained toilet construction masons or builders has led to some facilities being poorly constructed.

Improperly constructed facilities were reported in the category of semi-stable/ not stable conditions and were assessed not able to safely contain faecal matter hence increasing the risk of environmental pollution. Figure 5 shows the state of OSS facilities in the city.

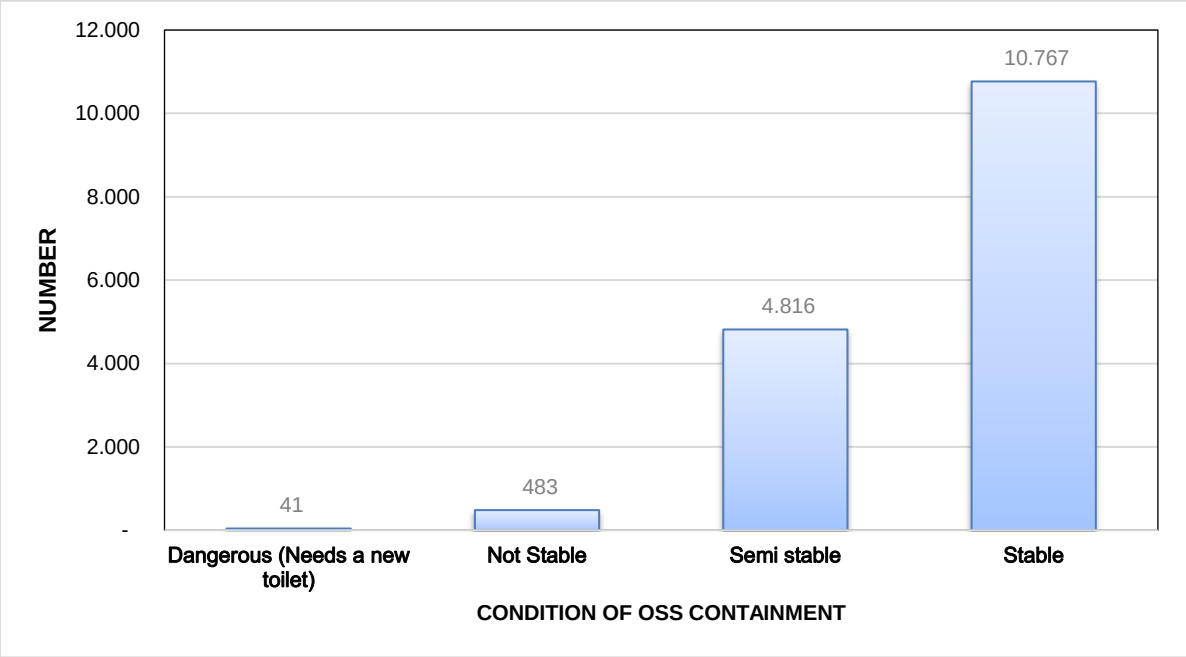

Figure 5: Condition of OSS Containment Facilities (Source: Sanitation Mapping Data, 2021).

Further, most of the OSS facilities in Kitwe are located on residential properties (Figure 6). However, public or communal sanitation facilities are found in commercial and public places and institutions such as markets, schools, churches and bars. According to the sanitation mapping data, a total of 3,550 public sanitation facilities were captured and the majority of these were in commercial or business places (Figure 6), which includes markets, shopping malls, bars etc.

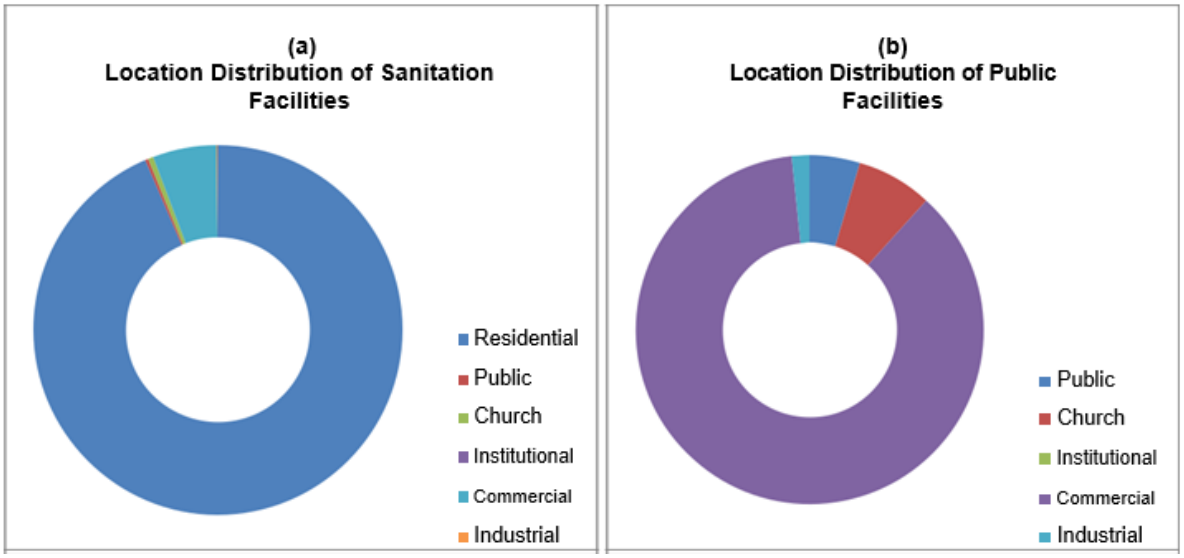

Figure 6: Location Distribution of Sanitation Facilities. (a) Pie Chart showing overall locational distribution of all sanitation facilities, (b) Pie Chart showing location distribution of public toilets only (Source: Sanitation Mapping data, 2021).

Furthermore 64% of these public facilities were connected to the sewer network and 19% were water borne facilities connected to a septic tank and a soak pit. Thus, based on these statistics, public facilities were not taken into account to avoid double counting since the potential users are most likely captured already at a household level. It should also be noted that very scanty information exists on the city's transient population. As such, this report does not take transient population into consideration.

Emptying and Transportation

Formal emptying and transportation services for OSS systems are not common in the district. Currently there are three active vacuum trucks operating in the district: two privately owned and one owned by NWSC. However, these mostly concentrate on servicing commercial/ institutional customers who need their facilities emptied. The utility vacuum tanker in some cases also services residential customers from middle- and high-income areas that are not connected to the city's sewer network. These vacuum trucks also service customers from other districts such as Chambishi and Kalulushi. All the emptying is formal and is therefore regulated by relevant authorities to ensure safe emptying, transportation and disposal. For example, it is mandatory for all emptiers to have full protective attire when emptying sanitation facilities. Transportation and disposal of the emptied sludge needs to also conform to the ZEMA standards.

Emptying services for pit latrines are almost non-existence in Kitwe City. There are currently no manual pit emptiers servicing the unplanned settlements who are on pit latrines. Thus, overall, it was estimated that less than 1% of the total faecal sludge that is accumulated in OSS systems is emptied and transported to the WWTPs. From the calculations, it was computed that only 0.4% percent of the population using OSS facilities had their faecal sludge emptied and transported to the treatment plant (Appendix 1). This was considered negligible and is not reflected in the SFD graphic. According to the Sanitation Mapping Report (2021), when respondents were asked about what actions they take when their containment facilities fill up, less than 1% reported emptying their containment facilities. However, it is possible that

the reported less than 1% of OSS emptied is an underestimation as very few respondents would willingly share information on using informal emptying services which are considered illegal.

It remains unclear what happens to the faecal sludge accumulated in containment systems that are abandoned when they get full. Most likely the residents resolve to other alternatives such as engaging informal pit emptiers and the use of chemicals. Further, 12% of the sanitation mapping exercise respondents said they abandoned their sanitation facilities once full and constructed new ones. Though informal pit emptying is mostly likely practised, there is no evidence to back-up the assertion. Thus, it was difficult to come up with a proportion of sanitation facilities that are emptied by informal emptiers and the sludge not transported to treatment facilities.

Faecal Sludge and Septage Treatment

Kitwe City has no septage/ or faecal sludge treatment plants, thus, the little volumes of faecal sludge that is emptied from OSS systems gets transported to the Nkana East - WWTP where it is co-treated with the wastewater. It should be noted that the practice of co-treating faecal sludge with wastewater is a delicate process requiring adequate control as the faecal sludge can easily overwhelm the WWTPs due to its concentrated nature. It is therefore imperative that the Commercial Utility (CU) considers having treatment plants designed to specifically deal with faecal sludge.

2.2 SFD Matrix

The Kitwe SFD was developed based mainly on the sanitation spatial mapping data that was collected in 2021 as well as field observations and discussions with NWSC staff as explained in Section 2.1.

The sanitation spatial mapping data together with data from other sources for areas that were not considered in the Sanitation Mapping Survey were aggregated to come up with representative data for the city. Table 3 shows the SFD matrix.

Table 3: SFD Matrix.

Kitwe, CopperBelt, Zambia, 16 Jul 2022. SFD Level: 1 - Initial SFD
Population: 757530
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	56.0	50.0	54.0			
T1A2C5 Septic tank connected to soak pit	5.0			0.0	0.0	0.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	6.0			0.0	0.0	0.0
T1A6C10 Unlined pit, no outlet or overflow	9.0			0.0	0.0	0.0
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	3.0					
T1B9 C1 TO C10 Toilet failed, damaged, collapsed or flooded, connected to sewer, soak pit, open drain or storm sewer, water body, open ground or 'don't know where'	11.0					
T2A2C5 Septic tank connected to soak pit, where there is a 'significant risk' of groundwater pollution	2.0			0.0	0.0	0.0
T2A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	1.0			0.0	0.0	0.0
T2A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	3.0			0.0	0.0	0.0
T2A6C10 Unlined pit, no outlet or overflow, where there is a 'significant risk' of groundwater pollution	2.0			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	1.0					

2.2.1 Distribution of containment facilities and population utilising the facility

Based on the sanitation mapping data analysis, together with data from observations, discussions and other reports like the Customer Perception Study especially for areas that were not considered in the Sanitation Mapping Survey, the distribution of common containment facilities was arrived at and is summarized in Table 4.

Table 4: Distribution of Sanitation Systems Selected to Generate the SFD Graphic.

Containment Technology	Proportion of Population (%)	SFD Matrix Classification
Offsite	**56%**	T1A1C1
Septic Tanks/ Conservancy tanks	**8%**	
Septic tank connected to a soak pit	2% 5%	T2A2C5 T1A2C5
Cesspit/ conservancy tank	1%	T2A4C10
All Types of Pit Latrines	**35%**	
Lined Pit Latrines	3% 6%	T2A5C10 T1A5C10
Unlined Pit Latrines	2% 9%	T2A6C10 T1A6C10
Pit Latrines which get abandoned when full	1% 3%	T2B7C10 T1B7C10
Flooded and damaged facilities	11%	T1B9C1TOC10
Open Defecation	**1%**	T1B11C7TOC9

Offsite: The findings from the rapid field visits, observations and desk-based study of sanitation infrastructure conditional assessment conducted in the past have revealed a number of issues with regards to sewer network collection efficiency. Due to the dilapidated state of the sewer network, sewer network loses were estimated at 50%. The estimated 50% losses were based on the SFD development guidelines which advocate for adoption of 50% where there is no data to give accurate values, thus variable W4a was set to 50%.

The major leakages arise due to the collapsed Mindolo and Chamboli sewer trunk mains which are supposed to convey wastewater to Nkana East and the Bulangililo WWTPs. Thus, it was obvious that all wastewater generated in Wusakile, Chamboli and Mindolo sewer catchment areas does not get to treatment plants but instead ends up in the nearby streams. In addition, there are high sewer blockages, missing manhole covers and leakages due an old dilapidated sewer network. Further, certain portions of the sewer network are vandalized by the community members and wastewater is diverted into gardens (NWSC, 2021).

The overall treatment capacity of the treatment plants was estimated at 54%, thus variable W5a was set to 54%. This estimation was based on the reports generated by NWSC on the treatment efficiencies of the treatment plants (effluent data) which are submitted to the regulators. The flows that bypass the treatment was also factored in to get to this estimation. Generally, a large proportion of wastewater ends up at the Nkana East WWTP which is overloaded and is in a bad state. Further, a certain portion of the flows (i.e., one inlet stream) is bypassed into the river without any treatment due to broken down mechanical screens and degritors. There is also no sludge treatment taking place at the plant as the aerobic digesters are not functioning. This situation has resulted in excessive accumulation of sludge in the

biological treatment units and the clarifiers hence contributing to the reduced treatment efficiency of the units.

Septic Tanks: Most septic tanks have been reported to be in a good condition. From those reported not to be in good condition, the main issues are the need for repairs/ rehabilitations due to cracks, missing manholes covers and blocked pipes.

Pit Latrines: The results revealed that 43% of the total population was estimated to be using various forms of OSS systems. Of this, about 81% (35% of the total) use pit latrines (both lined and unlined) and the rest are on septic tanks. It was estimated that 11% of these pit latrines get abandoned once full. This proportion includes both lined and unlined latrines as well as those that get damaged/ flooded during the rainy season. The assessment of the facilities that get flooded or damaged was based on the proportion of population that reside in low income/PUAs that are prone to seasonal flooding and the conditional assessment of the containment systems that was done during the sanitation mapping exercise.

2.2.2 Emptying of onsite technologies

Less than 1% of the total sludge accumulated in OSS containment systems gets emptied and transported to the treatment plant. This is due limited existence of formal emptying services in the city. Most of the facilities that get emptied are septic tanks (mostly for commercial/ institutional customers) which are serviced by a few vacuum tankers that operate in the city. Thus, variable F3 was set to 0% for all onsite sanitation systems.

2.2.3 Transport of FS from onsite technologies

The proportion of FS that is delivered to treatment has been considered to be negligible (variable F4 = 0%).

2.2.4 Treatment of FS from onsite technologies

There are no faecal sludge treatment plants in the entire city and thus, the sludge collected is transported to Nkana East WWTP where it is co-treated with wastewater. However, due to the negligible FS that reaches treatment (by setting F4 = 0% as previously stated), variable F5 for all onsite sanitation systems was set to 0%.

Open Defecation: There is uncertainty when it comes to the estimation of the actual proportion of Open Defecation (OD). Based on discussions with the NWSC staff, OD was estimated at 1% as it is said not to be prevalent in the city. However, OD is expected especially in public places such as Chisokone Market where the traders who come from other towns usually have no access to public sanitation facilities in the night when fee-paying toilets are closed. Further, OD is also suspected to be happening in some low income or PUAs such as Mindolo Section D and E where there are communal toilets like the one presented in Figure 7.

Figure 7: Communal Toilets in Mindolo Section D (LHS: Row of Communal Facilities; RHS: Inside one of the Toilets).

The residents talked to during the field visit in these areas cited limited access to the facilities due to congestion especially at peak hours as well safety issues at night since the facilities are located a distance from the households.

2.2.5 Groundwater Contamination Risk

Kitwe District covers an area of 815.76 km^2 and is underlain by a combination of basement complex (undifferentiated and granite) and consolidated sedimentary (upper roan dolomite and limestone) aquifers. The upper roan dolomite and limestone is a consolidated sedimentary aquifer with fracture flow and covers approximately a 1/3 of the total area on the western side of the city (Siwila and Buumba, 2021; O Dochartaigh, 2019). This is a highly productive aquifer with a water table between 20 to 35m below the ground surface. The rest of the district is underlain by the basement rocks (mostly granitic) with a crystalline basement aquifer with very low yields and productivity. Because of its high productivity, direct surface water recharge and fractured flow, the upper roan dolomite aquifer is highly vulnerable to groundwater contamination.

Figure 8 shows the hydrogeological map of Kitwe which highlights that the location of the upper roan aquifer coincides with the location of some low cost and PUAs such as Itimpi and Buchi which rely on OSS facilities (mostly pit latrines) for their sanitation needs and groundwater as sources of drinking water.

Further Kitwe west is characterized by new developments (mostly residential plots) with no access to piped water supply and sanitation services. Thus, most of the residents in these areas rely on groundwater which is abstracted through boreholes in the affluent areas and shallows wells in the low-income areas and PUAs.

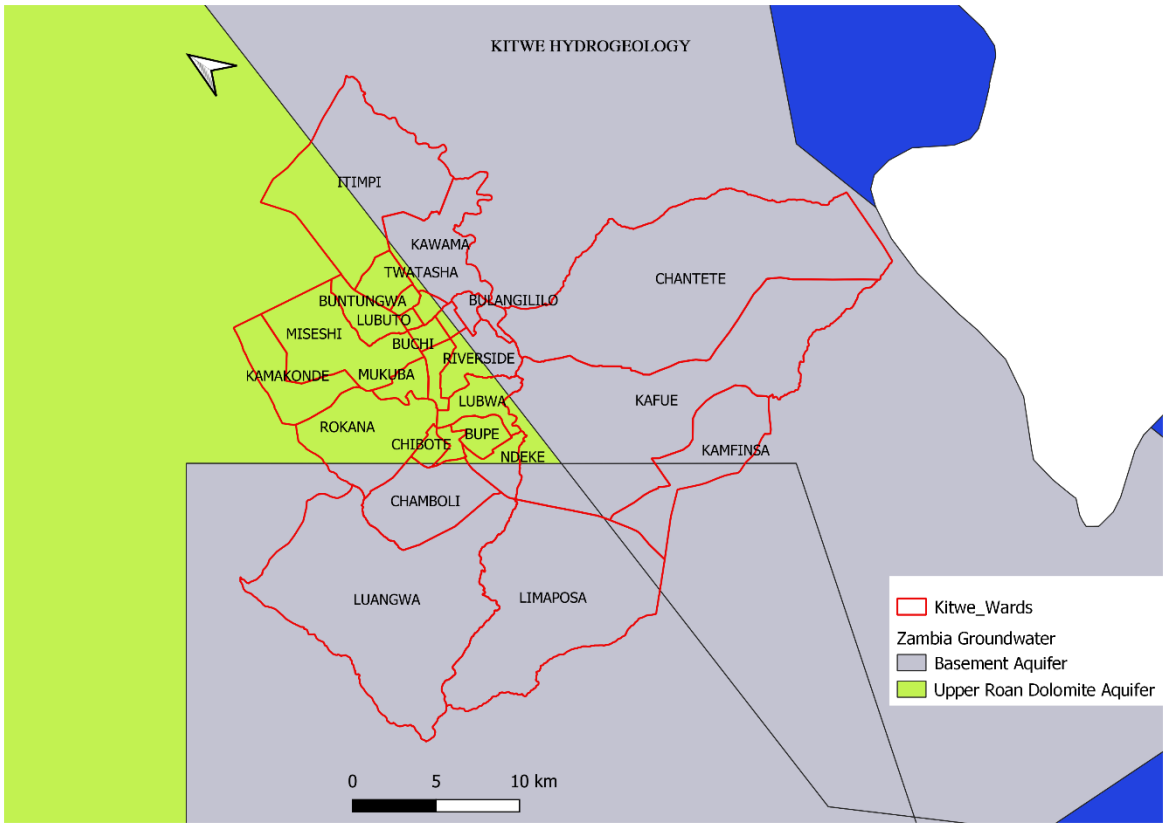

Figure 8: Hydrogeological Map of Kitwe District highlighting nature of residential areas sited of vulnerable locations (Source: O Dochartaigh, 2019).

Given this situation, it was assumed that 25% of the facilities (pit latrines) located in this area can be considered as high risk to groundwater contamination. This is backed by the findings of two studies that reported groundwater contamination with faecal matter in Kitwe west residential areas (Siwila and Buumba, 2021; Nyirenda et al., 2016).

2.2.6 Data Uncertainties

There remains a lot of uncertainties with some data that was used to generate the SFD graphic. The major data gaps that need further verification include:

- The proportion of OD;
- Proportion for transient population in the city;
- Detailed groundwater vulnerability studies;
- Proportion of the pit latrines that are emptied both by formal and informal emptiers; and
- Assessment of actual volumes of wastewater that is treated and the treatment efficiency.

2.3 Summary of assumptions

Offsite sanitation systems:

- ✓ 56% of the population are connected to the sewer system. It was estimated that only 50% of the wastewater is delivered to treatment (W4a = 50%) out of which, 54% is treated (W5a = 54%).

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.
- ✓ Emptying rate for all onsite sanitation systems was estimated at less that 1% and thus, variable F3 was set to 0% in all systems.
- ✓ The proportion of FS reaching treatment was considered to be negligible and therefore variables F4 and F5 were both set to 0% in all onsite systems.

2.4 SFD Graphic

The SFD graphic for Kitwe (Figure 9) shows that 62% of the population has their excreta unsafely managed while 38% has their excreta safely managed.

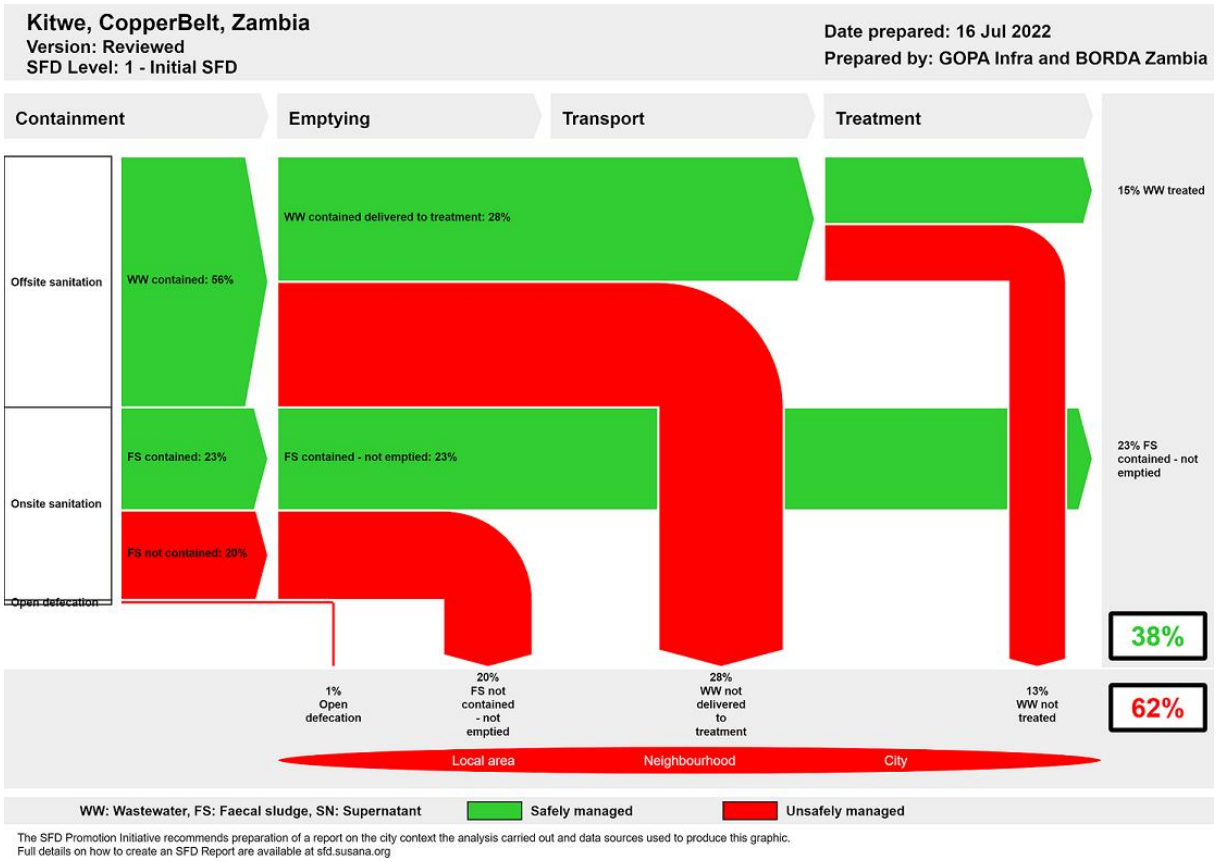

Figure 9: SFD Graphic.

There is almost an equal proportion of people using onsite and offsite sanitation systems in the city. The sewer network managed by NWSC currently only covers about 56% of the population and is in a dilapidated state requiring a complete overhaul/ rehabilitation so that it can be restored to its original operating and functionality conditions. Due to this, only about 28% of the population with offsite sanitation has their wastewater reaching the treatment facilities, with a total of only 15% estimated to be safely treated before disposal into the environment (15% WW treated on Figure 9). And 13% of the population are connected to a system where wastewater is not safely managed, due to the poor network and poor treatment efficiency.

On the other hand, 43% of the total population relies on OSS facilities such as septic tanks and pit latrines. Of the total faecal sludge accumulated in OSS containments, roughly half (23% of the population) has their faecal sludge safely contained onsite. And, since no faecal sludge is emptied and delivered to treatment plants, on the SFD Graphic this proportion is considered safely managed (23% FS contained – not emptied on Figure 9). However, for the population using septic tanks, this is a temporary situation as when these tanks become full, they will require emptying. If they are not emptied, they will overflow resulting in a significant public health risk.

As depicted in the SFD graphic, 20% of the population using OSS facilities have their faecal sludge not safely contained on-site (20% FS not contained – not emptied on Figure 9). Reasons for this situation include poorly constructed sanitation facilities and overflowing or damaged facilities which pose a risk to groundwater, and limited emptying services in the city.

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 Republic of Zambia (GRZ) has put up in place clear policies, regulations and legal frameworks for 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 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 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

At local level, NWSC has been undertaking various infrastructure projects to improve service delivery to its customers with the recent major project being the Nkana Water Supply and Sanitation Project Phase I (NWSSPI) funded by the African Development Bank. The NWSSPI implemented from 2009-2015, assisted NWSC improve its water production capacity, sanitation infrastructure (which include construction of 1,500 improved OSS facilities in selected Low-income Communities (LICs)) as well as promotion of sanitation and hygiene. As

a continuation, NWSC is currently implementing the Nkana Water Supply and Sanitation Project Phase II (NWSSPII). Both NWSSPI and NWSSPII form part of the NUWSSP. The NWSSP II will also aim at improving the existing water distribution and sewage collection systems, installation of water meters, and extension of services to new developments and PUAs. The program also includes communication programme focusing on water, sanitation and hygiene promotion, and support for OSS in some selected parts of Kitwe District.

UN 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 Sustainable Development Goals (SDGs) 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 urban, peri-urban and rural areas of Kitwe District.

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 10 shows the institutional and regulatory framework and outlines the various roles and responsibilities of the key sector players in Zambia.

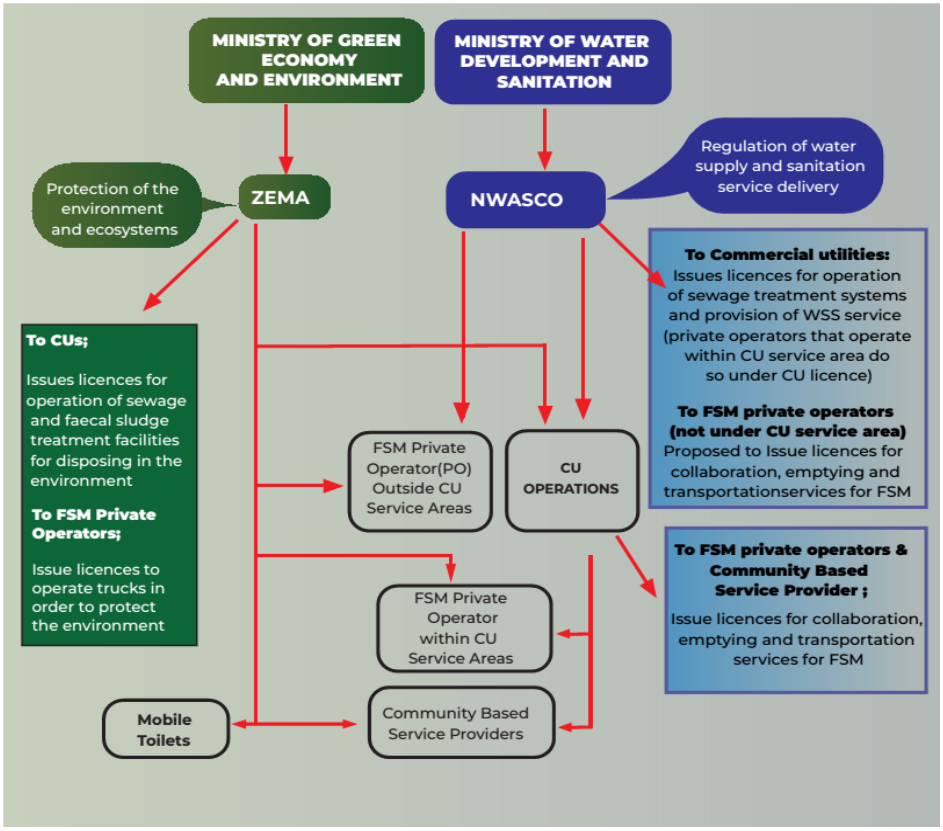

Figure 10: Regulatory Framework for Provision of Sanitation Services (Adapted from NWASCO, 2018).

At the local level, the following are the key players:

Kitwe City Council - Under the direction of Ministry of Local Government (MLG), Kitwe City Council (KCC) 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. KCC also holds the majority of the shares in NWSC and sits on the board as well as delegates' NWSC for water supply service and sanitation provision as per the WSS act No. 28 of 1997. KCC, 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. KCC 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 Kitwe City.

KCC also issues business levy licenses to all businesses operating in the city including service providers in solid and liquid waste management. There is however a weak enforcement when it comes to registration of businesses providing OSS and Faecal Sludge Management (FSM) services in the city.

Nkana Water Supply and Sanitation Company (NWSC) - NWSC is the commercial Utility delegated by KCC to provide water supply and adequate sanitation services to rural, urban and informal areas of Kitwe District and the two other districts under its jurisdiction (i.e., Kalulushi and Chambishi). NWSC is overseen and regulated by the National Water and Sanitation Council (NWASCO) and manages the current water supply and sanitation infrastructure for the city.

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 Kitwe District is done through new licensing conditions of 2018 issued to NWSC by NWASCO. Under the licensing conditions, any private operator providing sanitation services (e.g. emptying of OSS facilities) within the NWSC's designated service area will do so under a delegated management contract with NWSC. Private operators providing services outside the service areas of NWSC 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 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 local authorities.

The Public Health Act Chapter 295, Volume 17 of the Laws of Zambia: Mandates local authorities 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 local authorities to manage solid waste in the areas of operation. Poorly managed solid waste systems lead to indiscriminate disposal of municipal waste into onsite sanitation facilities, making emptying services challenging.

4 Stakeholder Engagement

The engagement with stakeholders was undertaken starting from the mapping exercise. Identified and engaged stakeholders for this study are presented in Appendix 2 and Appendix 3 in section 7. Discussions were conducted with key utility staff in relation to sanitation in the city. Telephone conversations with key stakeholders were made to explain the project and to arrange the days of the field trips and visits such as those conducted to WWTPs infrastructure as well within the communities. During the field visits, several observations were made which included wastewater treatment processes, types of sanitation facilities in Kitwe and the disposal of treated treatment plant effluent. Field visits to communal toilets were also conducted to understand how the sanitation technologies operate and how they contain the faecal sludge.

5 Acknowledgements

This SFD Report was compiled as part of the consultancy entitled "Support the Data Collection on Water and Sanitation for the Implementation of the ECAM Tool in Six (6) Selected CUs in Zambia" funded by the German Federal Ministry of Economic Cooperation and Development (BMZ) to Zambia which was commissioned by the GIZ.

We would like to sincerely thank the GIZ Programme coordinating Team including Christian Rieck, David Mondorf and Mwaka Sikazwe. We would also like to convey our sincere gratitude to our partners from NWSC including Derrick Ntonyo, Musonda Mukwavi, Edmond Chinkalanga, Brenda Kayombo, Gladys Kamoto, Francis Mwanza, and Benjamin Machuta. Lastly, we convey our gratitude to all those that assisted in one way on the other to the successful completion of this assignment.

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-Six 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 Computations used in the Generation of the Kitwe City SFD

POPULATION COMPUTATION												
Type of Sanitation facility	Number of residential facilities	% of facilities	average HH using facility	average ppl using facility	number of ppl using facility	% of ppl using facilities	ppl using facilities incl flooding + abandoned + OD	% of ppl using facilities	no ppl using containment that was emptied	% emptied	% emptied and transported to TP	treated safely
Flush/pour flush to piped sewer system	31,504	56%	1.0	6	189,024	56.5%	189,024	56%	189,024.00	100%	50%	54%
Leach Pit	542	1%	1.0	6	3,252	1.0%	2,439	1%	10	0.4%	100%	100%
Lined Pit Latrine	5,915	10%	1.1	6	35,490	10.6%	26,618	5%	106	0.4%	100%	100%
Lined Pit Latrine in HGW Risk area	1,479	3%						3%				
Septic tank with soak away	5,174	9%	1.1	6	31,044	9.3%	23,283	5%	93	0.4%	100%	100%
Septic tank with soak away in HGW risk	1,294	2%						2%				
Other (please specify)	190	0.3%	1.6	9	1,710	0.5%	1,283	0.4%	5	0.4%	100%	100%
Unlined pit latrine	5,276	9%	2	10	52,760	15.8%	39,570	9%	158	0.4%	100%	100%
Unline pit with HGW Risk	1,319	2%						2%				
Conservancy Tank	46	0.1%	0.9	5	230	0.1%	173	0.1%	1	0.4%	100%	100%
it was abandoned	62	0.1%	1.1	6	372	0.1%	279	0.1%	1	0.4%	100%	100%
Buried it and dug a new one	2,976	5%	1.2	7	20,832	6.2%	15,624	3%	62	0.4%	100%	100%
Buried with HGW risk	744	1%						1%				
Flooded Facilities	-						36,423	11%	146	0.4%	100%	100%
Open Defecation	-						3,347.14	1%				

7.2 Appendix 2: Stakeholder identification

Name of Organization	Name of Contact Person	Position	Influence (High/Medium/Low)	Interest (High/Medium/Low)
NWSC	Musonda Mukwavi	GIS Engineer	Medium	High
NWSC	Brenda Kayombo	Sanitation Superintendent	High	High
NWSC	Derrick Ntonyo	Manager – Technical Services	High	High
NWSC	Francis Mwanza	Lab Technician	High	Low
NWSC	Gladys Kamoto	Manager	High	High
NWSC	Benjamin Machuta	Manager – SHEQ Dept.	High	Low

7.3 Appendix 3: Tracking of Engagement

List of stakeholders that were directly engaged in the study	Date of Engagement	Purpose of Engagement	Maximum 100 words summary of outcomes
NWSC staff working in the GIS department.	4.02.2022	Agreement on city boundaries and map for Kitwe District.	Kitwe District boundaries established and map developed which defines the area of focus for the SFD.
NWSC staff working in the Sanitation department.	07.02.2022 – 11.02.2022	Understanding the level of services	Information on onsite and offsite services in the area was provided.
Gladys Kamoto	5.02.2022	OSS and FSM improvement interventions/ programs by the utility.	Interview was conducted and information provided on the plans and programs that NWSC has to improve OSS and FSM in the city of Kitwe.
Musonda Mukwavi	11.02.2022	Understanding and verifying OSS data from the sanitation mapping	Scope of the sanitation mapping understood including areas where data was collected from.
NWSC staff working in the Sanitation and GIS department.	11.02.2022	Discussion on the assumptions made on the SFD and estimation of OD proportion/ Groundwater contamination risks.	Discussion held and the proportion for OD agreed upon. Further the areas that are high risk to groundwater contamination were identified.

SFD Kitwe City, Zambia, 2023

Produced by:

GOPA Infra and BORDA Zambia on behalf of the GIZ Reform of the Water Sector Programme Phase II

This Executive Summary and the SFD Report are available from:

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SFD Promotion Initiative